THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. XIX. No. 467—22ND YEAR.] LONDON, AUGUST 30, 1870. [Subscription { 15s. in Advance. / 18s. Credit. per Annum.] DOUBLE No. Price 1s.

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10,000 cubic feet of gas per ton of coal.
26-candle gas.
13¼ cwt. coke per ton of coal.
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IMPROVED DRY GAS-METERS.

These Meters are warranted to measure correctly and not to vary, and have come into general use more rapidly than any Meters hitherto manufactured.

PARIS EXHIBITION, 1867.

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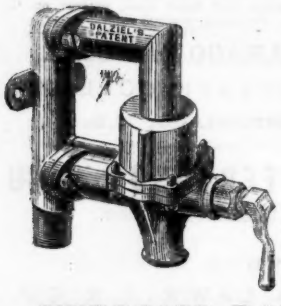

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WITH

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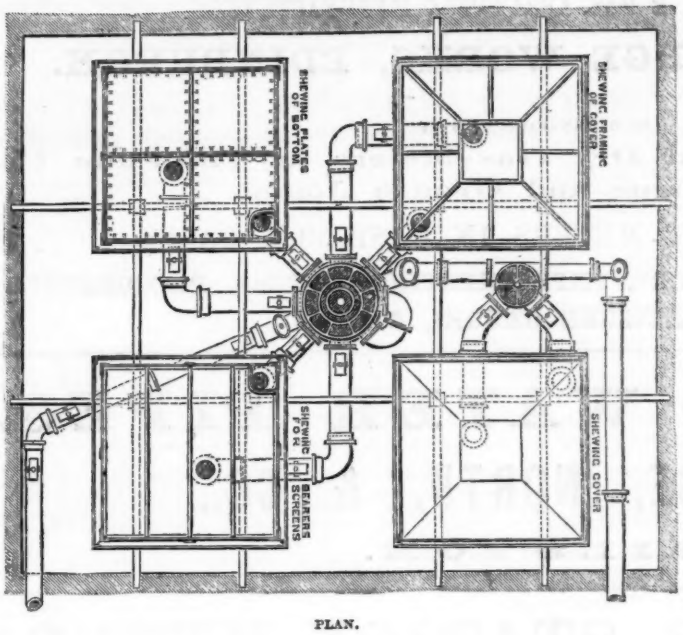
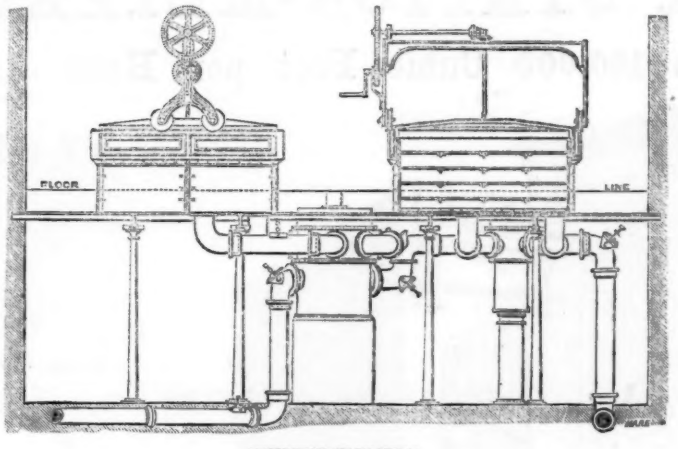


PLAN.



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The plan shows four Purifiers: three of them are worked in rotation by means of a central Valve, so that two are always in use, and the third always out of use for cleaning. By another arrangement of the Valve, either one, two, or three Purifiers may be used together.

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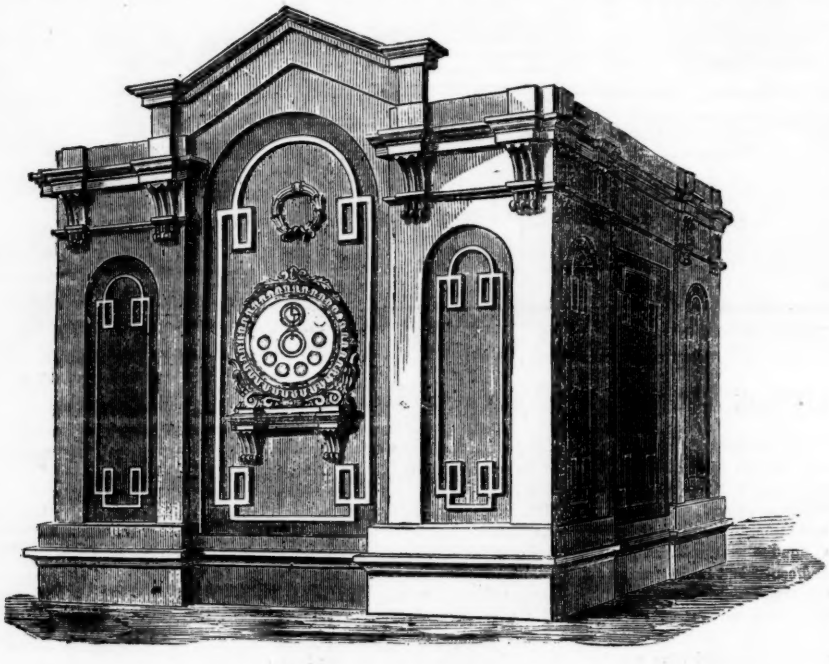

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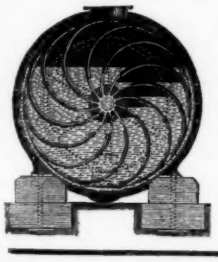

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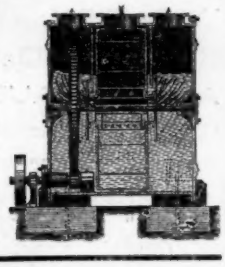

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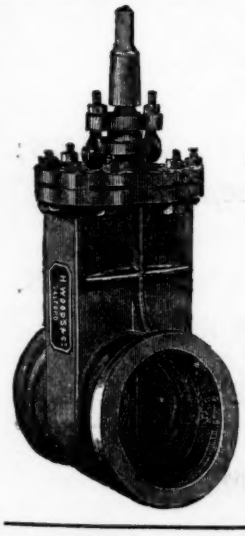

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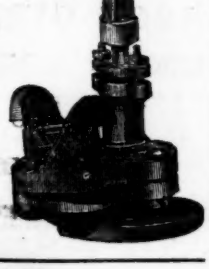

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Analyses by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

Description.	Cubic Feet of Gas per Ton of Coals.	Illuminating Power in Candles.	Coke per Ton of Coal used. Cwt.	Ash in Coke per Cent.	Sulphur in Coal per Cent.
Best Silkstone . .	10,900	17·0	12·8	2·6	1·7
Norfolk Silkstone . .	11,000	15·94	12·5	4·4	1·64
Silkstone Brights . .	11,500	14·5	12·6	7·4	1·85
Silkstone Nuts . .	10,800	15·85	12·66	6·0	0·69

NOTE.—The illuminating power of the Gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

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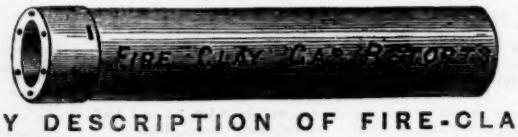

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

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SOLE MAKERS OF

MORTON'S PATENT SELF-SEALING RETORT-LIDS.

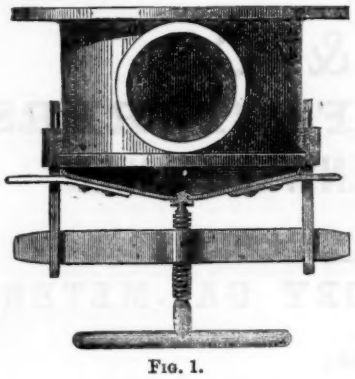

Fig. 1.

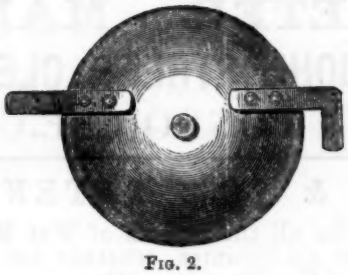

Fig. 2.

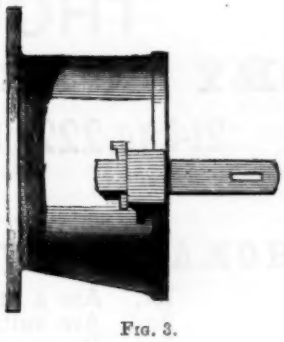

Fig. 3.

Several Hundreds in successful operation in various Gas-Works.

The expensive and cumbersome process of sealing the mouths of Gas-Retorts by means of luting the Lids with lime and other materials hitherto used for that purpose, is henceforth rendered unnecessary, and will be superseded by the very efficient method shown in the accompanying illustrations.

Fig. 1 shows a plan of a mouthpiece with Morton's Patent Lid in section. The mouthpiece is faced true, and the projecting circular edge or periphery of the lid is also turned true, and, by preference, of a semicircular section, so that the point of contact is reduced to a minimum; the convex form of the Lid rigidly sustains the force of the screw, which, by its central action, gives the Lid a uniform bearing, and effectually seals the mouth of the Retort.

Fig. 2 shows a front view of Morton's Patent Lid, which is stamped out of plate iron, having (in this case) ledges to rest on the lugs of the mouthpiece; these Lids, however, are more generally fitted to hinged cross-bars, by which means they remain suspended while the charge is withdrawn and the Retort charged, so that the damage done by throwing them about is entirely prevented.

The advantages obtained are—

1st. The sound sealing of the Retort during the whole time it is carbonizing the charge of coal, there being no jointing medium between the Lid and the mouthpiece.
2nd. The improved condition of the coke by the non-mixture of lime.
3rd. The Lid requires no preparation on the part of the stoker, beyond slightly scraping the surface to remove extraneous grit or dirt.
4th. The Lids are only about two-thirds the weight of the old form in general use, a Lid for a 16-inch mouthpiece weighing a little over 20 lbs.
5th. The Self-sealing Lid reduces labour, saves wear and tear, obviates all the inconvenience and discomfort consequent on the preparation of luting, and effects a great reduction in the working expenses. The cost attending the process of "luting" in several large gas-works, exceeds £1000 per annum, ranging in various works from 20s. to 35s. per mouthpiece.

It will be obvious that a round Lid is the most convenient and the cheapest form. D Retorts are adapted for round Lids, by carrying the bottoms down the necessary depth for that purpose, as shown in Fig 3. Some mouthpieces have been thus adapted, and are in use at the Chartered Gas-Works.

The following testimony speaks in favourable terms after ample and careful test:—

Burslem and Tunstall Gas Company, Longport, Staffordshire, Oct. 12, 1869.

Dear Sir,—In reply to your favour of the 9th inst., I have pleasure in stating that my admiration for your Patent Retort-Lid is most unqualified. I have 14 of them in use, and have tested them in the severest manner possible at these works, but without being able to detect the slightest defect. Yesterday the strap slipped off the exhauster, and a pressure of 13 inches was thus almost instantly thrown upon the Retorts, but although many of the luted Lids were leaking, not the slightest escape was observable from yours. I had anticipated that at least some greater degree of care would have been required in the scraping of the mouthpieces after the drawing of each charge, but even in this particular I find that labour has been reduced.

By every stoker on these works, as well as by myself, your Lids are regarded as a boon.

Please send me 30 more at your earliest convenience.

I am, &c., (Signed) HENRY WOODALL.

R. Morton, Esq.

Chartered Gas Company, Horseferry Road, Westminster, Sept. 15, 1869.

Dear Sir,—I have only lately returned to town, which is the reason I have not replied earlier to your inquiry.

I beg to say that I have had your Lids in use for upwards of two months, and during that time they have always kept a perfectly sound joint. I may add that where your lids are used only one set is required.

I remain, &c., (Signed) G. O. TREWBY.

R. Morton, Esq.

Chartered Gas Company, 146, *Goswell Street, E.C., Oct.* 20, 1869.

Dear Sir,—I have much pleasure in stating that, after some months trial of your Retort-Lids, I find them everything I could desire. I consider the plan a great improvement.

I am, dear sir, yours truly, (Signed) A. UPWARD.

R. Morton, Esq., London Gas Company.

These Lids are in successful use at the London Gas-Works, the Chartered Gas-Works, the Dublin Gas-Works, the Burslem and other Works, giving great satisfaction.

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London, 1851. New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865. Paris, 1867.

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PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

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DRY GAS-METER MANUFACTURERS,

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2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON & CO.,

(SUCCESSORS TO SAMUEL CROSLEY,)

COTTAGE LANE, CITY ROAD, LONDON, E.C.

Established 1816.

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STATION-METERS AND GOVERNORS,

PRESSURE REGISTERS, GAUGES,

EXPERIMENTAL METERS, PHOTOMETERS, GASHOLDERS, &c., &c.

WATER METERS.

W. P. & Co. beg to state that they are now prepared to supply Station-Meters with planed joints.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

NOTICES.

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THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, AUGUST 30, 1870.

Notes upon Passing Events.

WAR notes continue to be the only notes current in society. Amongst these the question of national defences holds a prominent place, and is the text for yard after yard of purposeless talk. Lord Elcho and Mr. Charles Buxton ought to be able to say something useful on a subject to which they have given so much attention as colonels and brigadiers of volunteers, but it is really astonishing how little that is practical is to be picked out of their voluminous correspondence with the daily press. At least it would be astonishing, if it were not well known that these two really clever men are both devoured by thirst for notoriety, and for political more than military reputation. Lord Elcho's prominent idea seems to be that more money would put the volunteers on a perfectly satisfactory footing. Mr. Buxton occupies nearly two columns of the *Daily News* in showing, first, that it is next to impossible to land forty thousand troops on our shores (if that be true, volunteers, in addition to militia, are unnecessary); and, secondly, that the volunteer system is perfect, and only shows badly when the aides-de-camp of reviewing officers impertinently interfere. The truth lies a long way from both these theories. England has more money, more idle men living at home at ease, more mechanical skill, and more taste for athletic games than any country in the world. But for forty years we did not think it needful, and now our rulers do not know how to utilize our natural advantages. In considering the question of national defences, the first point is the defence of our coast, harbours, and naval ports. Here the principal obstacle to efficient and economical work is to be found in the jealous ignorance with which military authorities regard the science and experience of civil engineers. As a matter of fact, modern small arms, modern artillery, and modern ships of war are all the result of civil science and practice, resorted to after the military authorities of Woolwich and the Admiralty Dockyards had come to confusion in their adherence to ancient precedents. Now, having learned something from the outside world of modern civil engineering, the military officials are trying hard to confine their manufactures to a military caste. For the latest example, let us turn to the controversy between Colonel Maxwell and Sir Joseph Whitworth, on the merits of Indian bronze field-pieces. Sir J. Whitworth has invented a metal nearly twice as tough, with nearly twice the resisting powers of bronze, and yet Colonel Maxwell, in a lecture on artillery, actually said that for field artillery there was nothing like bronze, and he considered that this preference was strengthened because the same opinion was held by artillerists four and a half centuries ago, when alchemy held the place of chemistry. In the preparation for the Abyssinian campaign, Lord Napier recommended, on the 12th of September, that a light railway should be sent, and laid down in Annesley Bay. On the 28th of September the Home Government—meaning, of course, the Horse Guards authorities, who equally despise civil engineers and men of business—decided that a railway was unnecessary; on the 10th of October they gave the Bombay Government permission to lay down a railway. Sir John M'Neil, Mr. Brassey, and General Simmons had all reported that a light narrow-gauge railway could without difficulty be laid from Annesley Bay, and Mr. Brassey was willing to undertake to lay one at the rate of five or six miles a week, at a cost not exceeding £3500 per mile. Nothing was done until the end of November, and then the Great Indian Peninsular Company would have supplied the rails, plant, and superintendence, but the extreme jealousy of Indian military authorities of civil engineers prevented so obvious an application being made. Finally, a railway was laid down to a terminus at some distance from the depôt. "The rails were old and crooked, "and of different patterns. The bolts did not fit. There were "two descriptions of chairs. The holes in the fish-plates and "rails did not agree. No augers were sent. The gauge was of "5 feet 6 inches (a favourite military crotchet), with a six-wheeled "locomotive; both gauge and locomotive being unsuitable for "the work. The railway did no effective work until April—even "then land transport was required between the terminus and "the depôt—and it cost nearly ninety thousand pounds!" This, with the precedent of the Balaclava railway to follow, which was sent out as complete as a box of toy-bricks, without one nail or a screw wanting! Again, in their evidence before the House of Commons committee on the cost of the Abyssinian expedition, Lord Napier, General Mansfield, and other military authorities concerned in the expedition, all agreed that direct telegraphic communication between Suez and Annesley Bay would have saved a large sum of money out of the £9,000,000 spent on this expedition. Proposals for laying down a cable, at a cost of £60,000, were rejected by the home authorities. The Duke of Cambridge's Horse Guards staff hate telegraphs and all other new inventions; they will not let "a fellah" sleep quietly in his bed. The regular Horse Guards cry and echo are that our national defences are imperfect because Parliament and the Chancellor of the Exchequer are so parsimonious. A study of this Abyssinian evidence will show how little military men, who pride themselves on being "soldiers, and not men of business," are to be trusted with unlimited funds. A few examples will show this. Officers speaking no language but English, and with no knowledge of mules, were favoured with the agreeable appointment of travelling at national expense to buy them. A minimum height was fixed which excluded the best animals. Thirty pounds each was given for a thousand Spanish mules, when much better animals were to be had for £17. No arrangements were made for receiving and feeding these animals, although millions were spent on fodder. A thousand died from want of fodder and attendance before the expedition landed. Twenty-eight thousand mules and camels were destroyed or abandoned, besides 18,000 obtained in the country. The advance was seriously delayed for want of the transport animals, which had died after costing on an average

£40 a head, because no proper care or food had been provided by military authorities with unlimited funds at their disposal. The main cause of the inefficiency of the transport was the engagement, by order of the Home Government, of Egyptian and Syrian muleteers, instead of taking muleteers from India. The Highland transport train, composed of Punjaub muleteers and the Bengal brigade, in marked contrast, were efficient; the officers could talk to their muleteers. Four times as much hay as Lord Napier asked for was sent to Annesley Bay. The greater part was never unshipped, and kept on board at an expense of £125,000 per month! These are the sort of follies to be expected in the management of an army where a commanding officer proudly answers, "I am a soldier, "not a man of business;" but the modern art of war consists as much in feeding and clothing troops as in fighting. The ordinary type of British officer would treat with scorn the idea of investigating such a detail as soldiers boots, and he would not be appreciated at head-quarters if he went seriously into such a matter; yet shoeing an army is like the old tale, "for want of a nail, the "shoe was lost," &c. Half the success of an army depends on quick marching. No one of any experience will contend that in this country of cricket matches and running matches the raw material of the army are not equal to walk or run with any nation in the world. They become slow when recruited into the army in consequence of villanous shoeing and bad training. Thus the good feeding of the British soldier only makes him slow, and slow, in a campaign, is by no means sure. The volunteer movement has given the nation a large body of active fellows trained in the rudiments of drill, and good shots—much better shots than regular soldiers, because more intelligent and with more means for practice at ball-cartridge. The weak point of the volunteers is in officers, who are naturally selected for their influence and money, because not only has a volunteer captain to pay his own expenses, but generally to contribute to the expenses of his company from £10 to £50 a year. It is impossible to insist on an efficiency test of volunteer officers beyond elementary drill, unless they are relieved from all charges beyond their personal expenses; nevertheless, the attention volunteer officers have in many instances given to military matters has been of service to the country by qualifying them as political critics in opposition to the red-tape and pipeclay school of military authorities.

The vice of the British military system, which affects in relative degrees the regular army, the militia, and the volunteers, is that to a very large section of the higher and richer classes the army is not a profession, but an amusement. Aptitude, assiduity, and physical qualifications go for very little unless the officer enjoying them has not only a fair share of money, but good influence. The effect of influence cannot be abolished under any form of government. "Kissing will always go by favour," more or less, but testing-sieves may be created through which it is impossible for ignorant, lazy, feeble-bodied ensigns and cornets, lieutenants and captains, to pass. At present the sons of rich tradesmen and manufacturers enter the army to obtain social positions, and find themselves associated with a great many officers of good families, small fortune, and good interest. In every other profession the man who wishes to succeed, however well connected, must obtain a character for knowledge of that profession. It is not so in the army. The son of the linendraper or tailor who becomes a cornet or ensign, finds that the cardinal virtues of a British officer are to be gentlemanly in manners and liberal in money matters, clever in field sports, and able to master enough drill not to disgrace the regiment. With these qualifications, enough money to purchase his way up to lieutenant-colonel, enough brains to manage a pass, any pupil teacher could pull through; with feeble eyesight, a childish voice, a bad seat on horseback, and just enough strength to drag through one day's march, with occasional lifts, he may live to command a regiment at thirty-six, and be a general by the time he is fifty, at a cost of from £15,000 to £20,000, and be a very dear bargain to the country at the money. It is, no doubt, an advantage to the nation that the army should be largely officered by noblemen and gentlemen of fortune, and not entirely by mere soldiers of fortune, provided they are mentally and physically efficient. At present every crack regiment has a leaven of officers who enter the army as amusement for a few years, to wait for an hereditary title or to get into good society. These assume an air of superiority over the "*saps*," who seriously study the profession of arms. The same tone prevails in the militia, where a commission is usually valued as a social distinction. As we have before observed, we have the raw material and plenty of ability amongst *gentlemen*, if our system be so altered that efficiency be considered the road to distinction, instead of the whole art of military social success being—

> To bow with a grace,
> Have taste in furs, feathers, cuirasses, and lace.

The death of Sir John Thwaites has called out a good many candidates for the chairmanship, whose principal qualification is the want of £2000 a year and something to do. Sir William Fraser, who has been paragraphing himself, is a baronet, once Conservative M.P. for Barnstaple, who has written a pamphlet on street-cleaning, given a medal for the champion swimmer of London, and enjoys the reputation of objecting to any sanitary process connected with soap and his own person. The rumour that Mr. Ayrton would descend from the post of First Commissioner of Works to be the Ædile of London vestries, must be a joke. Men like Mr. Ayrton may be beaten in the battle of public life, but they do not commit political suicide, especially after the warning from the Home Secretary that the chairman of the Metropolitan Board must be elected subject to the changes which may be effected in metropolitan government by a Bill to be introduced next session. The name of one gentleman has been mentioned as a successor to Sir John Thwaites, who seems to unite all the necessary qualifications—Mr. M'Cullagh Torrens. He has been trained in an administrative office, he has had long parliamentary experience, he is an educated and accomplished man, a fluent speaker and writer, perfectly acquainted with the duties of chairman of a committee, and endowed with the essential temper and tact for such an office. Whether he has enongh decision of character—what the Norwegians call "bone in his nose"—remains to be proved. At any rate, he would give the Board the best chance of increased powers, and would well represent the metropolitan as distinguished from the Corporation of London interests in the House of Commons. Since he was elected for Finsbury, Mr. Torrens has been rather in a false position. In deference to the ignorant prejudices of the lump of his supporters, he has pledged himself never to take office under Government—a most absurd pledge, given, no doubt, under compulsion. It would be difficult to show how an able man can serve his country better than by taking an office for which his talents and qualifications fit him. In consequence of this pledge, Mr. Torrens has been most distinguished during the last two sessions by the captious opposition of an Irreconcileable. He has, however, managed to press one excellent measure for the destruction of metropolitan fever nests. As chairman of the Board of Works he will have an opportunity of still further developing his energy and intelligence in the same direction, and the Board will gain new credit by works of destruction, those of construction being completed.

Decidedly commercial undertakings founded on ingenious inventions are not fortunate. Mr. Fell's Mount Cenis Railway, supported by all the talents, is about to be wound up—not from any failure in the contrivance for making railway trains over steep ascents, but because there is not traffic enough possible to produce a profit after paying for repairs. The richest amateur engineer in the world, and the most careful of his money—the Duke of Sutherland—was chairman of the Mount Cenis, and has, no doubt, led a good many, less endowed with worldly goods, into the "awful sacrifice." Some years ago a company was almost formed out of the Institution of Civil Engineers, to work a most ingenious patent for building boats by machinery; but there was a hitch in the commercial arrangements, and a speedy winding up engulfed the capital of the shareholders. Again, Mr. Edwin Clark's hydraulic graving dock on the Thames was introduced under the chairmanship of the greatest engineer and mechanic of the day, found its capital chiefly amongst the engineers of the most select Great George Street circle, and has never paid even interest on its debentures, although the mechanical arrangements fully realized the first expectations. In a word, patents are like mines—one per cent. produce brilliant results, the rest fail to find a balance over working expenses. Engineers of the passing generation were not trained to economical views.

The creditors of the London, Chatham, and Dover are beginning to see daylight, and the unhappy shareholders now know that they will get a dividend whenever the traffic returns are doubled, which is within the bounds of possibility. It is certainly one of the signs of the times that a great nobleman and politician and an ex-Chancellor should devote themselves as volunteers, without the slightest scrap of glory or honour, to the task of a most difficult arbitration, in a case that would have lasted Lord Eldon his whole judicial life. A fortunate people we are, if we only knew it, to have an elaborate and costly system of railway communication between the English Channel, London, and all the northern and midland railways, without the cost of a penny to the nation or the parishes traversed. This becomes more striking now that the L. C. and D. (the name really is too long) has commenced to book from the Metropolitan Moorgate Street Station, alongside the Great Western and Midland, and to share the services of their able traffic manager with the Metropolitan. The Great Eastern is also hard at work to join on the underground system, and tap the North London outer circle at Broad Street. What would Paris now be willing to pay for the metropolitan network which unassisted and much-abused private enterprise has executed for London!

Circular to Gas Companies.

THE appointment by the Board of Trade of Mr. William Pole, F.R.S., as one of the referees under the City of London, Imperial, and South Metropolitan Gas Acts, in place of Mr. F. J. Evans, who some months since tendered his resignation, will be received with satisfaction by the public, as well as by the metropolitan gas companies. Mr. Pole is favourably known to our readers as the author of several able papers on the flow of gas through pipes, which have appeared on various occasions in our columns, and his appointment will infuse new blood amongst his colleagues, from whose labours neither the public nor the gas companies have hitherto derived the advantage that was expected.

There is something so astounding in the announcement that some of our methods of purification add to the amount of sulphur in forms other than that of sulphuretted hydrogen, that we think we may justly complain that precise details of the experiments which have led to this conclusion have not been given in the referees report. We should have been told, for instance, what kind of oxide was used, and how it was used; for it is conceivable that, in the passage of gas under some pressure through a layer of heavy bog ore three feet thick, reactions might take place which would not happen with lighter oxide differently distributed, and with the gas under less pressure. In the former case the conditions would somewhat resemble the passage of mixed gases through the pores of charcoal, where, from the intimate contact into which the gases are brought, chemical changes take place which do not occur under other circumstances. Next we ought to have been informed what apparatus was employed in the estimation of the sulphur. The Letheby apparatus, even in the most capable hands, is liable to give discordant results, and, for aught we know to the contrary, variations just as great may be obtained with the new sulphur test. In Dr. Odling's hands, it is true, the new apparatus gave remarkably uniform results; but we have at present no assurance that in the hands of ordinary experimenters the referees test may not fail to give results equally uniform. In fact, it seems to us quite possible, and we think it probable, that the apparent addition of sulphur compounds to the gas in the experiments mentioned is the result of errors in the estimation of the sulphur. Nothing but the adoption of rigorously exact methods of determination, such as we mentioned in our last, would convince us that such a transformation of sulphur compounds as is supposed, takes place under any circumstances, and then we require to know the circumstances under which it does happen.

The results of the testings for sulphur given in the report we consider highly instructive. They show clearly the value of different modes of purification, and it is desirable that we should know what these modes are. The method pursued by Mr. Harris at the Great Central works obviously at times reduces the sulphur to a minimum, and the average results are nearly as good as any obtained in the kingdom. For this reason the publication of a full description of the plan would have been valuable. The daily fluctuations are, as it is said, somewhat embarrassing, but not, perhaps, altogether inexplicable. On looking at the numbers, there seems to be a tendency to (not very pronounced, it is true, but still enough to excite a suspicion that there is) a gradual rise from a minimum to a maximum, and we should like to know what changes were made in the purifiers in the intervals. With Mr. Mann the results of purification are much more uniform, a circumstance he and the referees are unable to explain. But surely the explanation is to be found in the method pursued, if we only knew what it is. To say that it is not due to chemical science and appliances, but to the perfection of mechanical details, is no information at all. But we think it may be due to both. Mr. Mann, for one thing, carefully picks his coals. Now the picking of coal is a mechanical detail, but the careful exclusion of pyrites from the retorts is a chemical reason why the sulphur in the gas should be a small and uniform quantity. The great defect of the report is the absence of information. There is this practical fact in the table we print on page 620—viz., that in the year 1869-70 the average amount of sulphur in the Great Central gas was 12·6 grains; in the City, 19·8 grains; in the Curtain Road, 21·6 grains; in the Brick Lane, 24·7 grains; and in the Westminster, 28·8 grains. Now the great business of the referees should have been to have ascertained precisely the causes of these large differences (for they are in the working processes), and to have applied the results for the benefit of gas managers and the public. Instead of this they appear to have been groping about in the dark for things which lie out in the broad daylight.

We insert in another place a communication from Mr. George Livesey, which expresses, it is hardly necessary to say, views with which we, for the most part, perfectly coincide. We do not, however, think it advisable that gas engineers should set themselves in opposition to the public on this sulphur question. The results at the Great Central and City works show how much can be done in the way of purification from sulphur, and their publication is likely to cause invidious comparisons to be made with the gas of other companies. The question for engineers to consider is how to obtain equally favourable results, according to their means, and, if possible, to improve upon them. Nothing has done so much to promote agitation on gas matters as the position of apparent antagonism to the public, which the companies have at times taken up; and since this agitation is still more or less active among our public bodies, it will be well without delay to do all that is possible to satisfy popular demands.

It will be seen by the report of the directors of the Imperial Gas Company, submitted to the last general meeting, that the reduction in the price of gas from 4s. to 3s. 9d., made in pursuance of the Act of 1869, has caused a falling off in the gas-rental of £12,565, and that £8607 has to be withdrawn from the reserve-fund to make up the amount required for the payment of the half year's dividend.

We commence in this number a report of the proceedings at the ninth annual meeting of the North British Association of Gas Managers, recently held at Edinburgh. The chairman's opening address was of an eminently practical character, dealing chiefly with tests for illuminating power, and the Sunday labour question. In connexion with this latter subject, he gives an ingenious diagram, showing the way of working the eight-hour shift system, so as to secure to each squad a long rest every third week. The plan has many recommendations, and we should be glad to see it adopted; but we fear that any change for the moral benefit of the men which involves a reduction of wages by one-third, would be stoutly resisted even in Sabbath-keeping Scotland. One peculiar feature in this Northern Association is the offering of prizes for papers on given subjects—a plan which might, perhaps, be advantageously followed by their southern brethren.

The committee of the Sheerness Local Board have not yet reported on the plans and specifications for the erection of gas-works. The several members, it appears, wish to take the documents home and study them at their leisure; but the surveyor objects to letting the specifications out of his possession. Until this difficulty is got over, or the committee can be persuaded to inspect the papers at the surveyor's office, we can have no report. In the meantime we have, for the present, heard the last of the proceedings of the Board, which now meets with closed doors. This exclusion of the public and the press from the meetings seems to indicate the intention of perpretating some job which will not bear the public light. Under such circumstances we are not surprised to see that a ratepayers association has been formed, with a view to improve the character of the Board at the next election.

A correspondent writes to us that some of the Government establishments deny that they are bound by the provisions of the Sales of Gas Act, and insist on being supplied with gas through the unstamped meters at present in use after the 13th of October next. The Act, however, contains no exemptions, and the Government authorities are in this respect in the same position as private individuals, and must conform to the law by providing themselves with stamped meters, if they wish to continue to be supplied with gas.

The war which is now desolating the fairest provinces of France has naturally depreciated the value of the shares in such English companies as are engaged in the supply of gas in French or German cities. On war being declared, the shares in the Imperial Continental Gas Company fell £5 or £6 per share, as it was feared that their properties at Berlin, Frankfort, Cologne, or Aix-la-Chapelle might be in jeopardy; but now that the tide of war has been rolled back upon French soil a recovery has taken place, and the value of the shares has risen to nearly the price current before the breaking out of the war. The gas-works in the besieged city of Strasburg belong to the Continental Union Company. The Paris Gas Company are vigorously preparing for a siege, and are proposing to make within the fortifications all the gas that may be required, and have accumulated a stock of coal equal to 80 days probable consumption.

Correspondence.

ON THE GAS SULPHUR QUESTION.

SIR,—The very exhaustive, able, and honest report of the London gas referees on this subject, which appeared in your last issue, opens the way to further discussion. So much has been said and written during the last ten or fifteen years about the sulphur compounds—other than sulphuretted hydrogen—which cannot at present be removed from coal gas, that there is danger lest all improvements in gas manufacture and attempts to cheapen its production should be held in abeyance until this question is settled; and considering that no progress whatever—unless a retrograde movement can be called progress—has been made towards this end, gas men and chemists have an arduous task before them.

It is possible too much importance is attached to the removal of

these sulphur compounds—this being the term used to conceal the universal and complete ignorance of their chemical composition. Sulphur, in some form or other, is present in minute quantities in purified gas, not, it is now said, as bisulphide of carbon, and here our knowledge ends.

Enthusiastic scientific men are sometimes so carried away by their ardour in investigating a subject, that they forget the practical and useful; it may be that this gas sulphur question is a case in point. It will be well, therefore, to consider it in a common sense view, and with this object two questions may be put:

1. What is the proportion by weight which the sulphur bears to the gas?

2. Can this very small quantity of sulphur produce any injurious effects whatever?

The Act of 1860 impotently prescribed that the quantity of sulphur in 100 cubic feet of gas should not exceed 20 grains, which was certainly "a leap in the dark," for if the last ten years have done nothing else, this has been proved, that the sulphur almost invariably present exceeds 20 grains.

The method of stating the quantity is manifestly unfair; it simply misleads the public for whose benefit the tests are made. The 20 grains to all ordinary people is unintelligible; they may think it means 20 parts in 100, or a twentieth part, or anything else; had it not been so we should not have heard or seen in print the expression the "enormous quantity of 25 or 30 grains" so often used.

One hundred feet of common gas, at specific gravity ·422, weighs, say, 22,500 grains.

20 grains of sulphur in 100 feet	= $\frac{1}{1125}$	part, or	·00088
25 " "	= $\frac{1}{900}$	"	·0011
30 " "	= $\frac{1}{750}$	"	·0013
35 " "	= $\frac{1}{643}$	"	·0015

Had the quantity been expressed decimally or fractionally, every one would have understood it.

In an average sitting-room, with three burners, 100 feet of gas is not consumed in the course of a winter's evening, but taking it at this rate we have during the five or six hours, say, 40 grains of sulphur—if you like—converted into sulphurous acid; but the 1-15th of a foot of sulphurous acid gas thus produced does not—owing to the wonderful law of the diffusion of gases, and also to the continual change of air in the room—accumulate, but becomes infinitely diluted and carried away, so that by the most delicate tests its presence cannot be detected. On this question Dr. Versman has shown that the burning of three ordinary lucifer-matches in the course of an evening produces as much sulphurous acid as the gas.

Dr. W. Odling, Fullerian Professor of Chemistry at the Royal Institution, in a lecture delivered on the 2nd of June, 1868, shows most conclusively the sulphur bugbear to be all moonshine. He says:—

I am altogether at issue with the public when they maintain that the sulphur of gas produces, by its combustion, oil of vitriol, or that the amount of sulphur ordinarily contained in gas is of any consequence whatever, and a little consideration will, I think, satisfy you of the soundness of this position. We will assume that coal gas contains not 20, but 40 grains of sulphur in 100 feet, a quantity at any rate greatly exceeding the reality. Now, making another extravagant assumption, that the whole of these 40 grains of sulphur would be completely burned—and in reality they would be burned very incompletely—they would furnish by their combustion 80 grains of sulphurous acid gas. This quantity of the produced sulphurous acid would occupy at ordinary temperatures about $\frac{1}{13}$th part of a cubic foot; and since 100 cubic feet of our coal gas gives $\frac{1}{13}$th of a cubic foot of sulphurous acid, 1500 feet of coal gas would be required to furnish 1 cubic foot of the acid, even upon the extravagant assumptions we have purposely made. But the combustion of 1500 feet of coal gas would produce something besides sulphurous acid. It would produce at least 1000 cubic feet of carbonic acid, and, in addition to its dilution with other gases and vapours, we should have our sulphurous acid diluted by 1000 times its volume of carbonic acid. Now, if we can get at the proportion of carbonic acid in the atmosphere of a room highly illuminated with gas, and take the thousandth part of that proportion, we shall be able to form some notion of the amount of sulphurous acid present. You will remember that the amount of carbonic acid furnished by the breath of one individual is equal to that furnished by two 3 feet gas-burners, and that the maximum amount of carbonic acid found in the atmosphere of a crowded theatre was 0·32 per cent. Now, if in addition to our previous unreasonable suppositions, we further suppose that an atmosphere contains 0·2 per cent. of carbonic acid furnished by gas combustion, you will see that the whole matter becomes a *reductio ad absurdum*—that we might actually have one half-millionth part of sulphurous acid present in the air of a gas-lighted room.

Dr. Schilling says, in his *Journal für Gasbeleuchtung* for 1869, p. 484: "20 grains of sulphur in 100 cubic feet of gas are entirely unobjectionable. Under the most favourable circumstances, with *no ventilation whatever*, it would give the atmosphere of a room only one part of sulphurous acid in 500,000 parts of air."

Taking, therefore, a practical view of the question, may we not ask, Can this ridiculously small quantity of sulphur produce any injurious effects whatever? It has been assumed, without proof, that it does cause great mischief and inconvenience. Is it injurious to health? Supposing for a moment that sulphurous acid exists in the atmosphere of a gas-lighted room, has not the human frame been endued with powers to meet and throw off impurities with which it may come in contact? How is it that Dr. Tyndall's "dust" does not kill us all, or the Registrar-General's "tons of solid impurity" in the water of London have the same effect, though, by the way, the so-called solid impurity in the water is really part of the water—lime for instance—and a part necessary to health? Further, the noxious gases given off in towns, and in the country, too, by natural causes, which concentrated, are poisonous, are compelled by that beautiful law to which reference has been made to become infinitely diffused, and thus rendered harmless. It may be safely contended that the sulphurous acid produced by the combustion of gas never had any injurious effect on the health of any human being; and, further, its presence is never felt by the delicate organs of smell or taste, and those organs are specially susceptible to sulphurous acid. The oppressiveness felt in a close room where gas is burning is stated by Dr. Letheby to proceed from the large amount of heated vapour of water produced by the combination of the hydrogen of the gas with the oxygen of the air, whereby the air of an apartment is overloaded with heated moisture, thereby checking the insensible perspiration from the body. Were our rooms properly ventilated—instead of being constructed like a diving-bell, with the outlet at the bottom, but inferior to a diving-bell in having no proper inlet for fresh air—this heated vapour would be carried away.

An unpleasant smell is sometimes noticed—attributed to sulphur, of course—when gas is burning, which is the result of imperfect combustion; a very common occurrence, and to remedy which the gas referees have done good service both to the public and to the gas companies by investigating and exposing the defects of the wretched burners in almost general use; they simply diminish the light 50 per cent., and often vitiate the air by the imperfect combustion of the gas.

But if the human frame is susceptible of no injury or inconvenience from this sulphur, it has been stated that the mischief done to dry goods, hardware, and plate, is unquestioned, to which may be added the leather bindings of books, and the celebrated boots of Mr. Medwin, of Regent Street, who demonstrated (?) it by tearing up some of them before a parliamentary committee.

The question may be asked, Do not dry goods, whatever they are, hardware and plate, books and boots, deteriorate or tarnish where there is no gas at all? Leather will rot from other causes than the sulphur in gas, for in libraries where it is not used the bindings of books have become rotten, but probably not so quickly as where gas is burned. The excessive quantity of heated moisture, to which reference has been made, which exists in greater quantity in the upper part of the room, does the mischief to the bright work and to the books, and not the absurdly small quantity of sulphurous acid that may exist.

It is quite possible sulphurous acid does not exist at all, it being neutralized by any alkaline substance, such as ammonia, which is probably present in small quantities in our rooms, and if it is not thus neutralized, may it not combine with the lime on the ceiling? It is possible the small quantity of sulphurous acid may be a decided benefit acting as a disinfectant. This is mere supposition, and is therefore on a par with the assertion we are combating.

To sum up what has been written, I would say the amount of sulphur in an unknown form left in purified gas is so very small that it can be productive of no injury whatever, either to health or to goods of any description.

An attempt has been made to impose on the gas companies, under heavy penalties, conditions which, with present knowledge, it is impossible to comply. The late Mr. Alfred King, engineer to the Liverpool United Gas Company, than whom no man stood more high in his profession, and also in his private character, said to me in 1866: "When we went for our last Act, I said to the corporation, in reference to this sulphur question, 'I am perfectly willing to do anything that can be done, but I will not be bound to do that which there is no known means of doing.'" The corporation wisely acquiesced. The Liverpool Gas Company takes the lead in the matter of price and illuminating power in this country, and the Liverpool consumers do not find any inconvenience from the absence of restrictions as to sulphur.

Gas companies, I know, would be very glad to be able to remove the sulphur, if any practical means could be discovered. By practical, I mean efficient and inexpensive, both as to cost of material and labour, and non-reduction of illuminating power. The cost should not affect the price of gas even to the extent of 1d. per 1000 feet; this amount on at least 10,000 millions of feet consumed in London in a year makes the enormous sum on £41,650—quite sufficient to regild all the cornices, rebind all the books, and replace all the boots many times over that are alleged to be destroyed by the sulphur. If the sulphur can be effectually dealt with at a cost of 1d. per ton of coals used, it would be worth doing.

All that has been done towards removing these sulphur compounds has been an attempt to return to the use of lime, which at the best gives very uncertain and fluctuating results. It is objectionable on many grounds. The illuminating power suffers, it is more expensive, requires more labour, gives more pressure, and is such an intolerable nuisance, that its use is utterly impossible in most neighbourhoods. Lime, and lime alone, has given the gas-works the character they possess of being a nuisance; until the last twenty years lime was exclusively used, and with the small make of gas in those days—one-fourth only of the present quantity—the stench was so patent to all the inhabitants for half a mile round a gas-work, that the companies were forced against their prejudices to adopt the oxide process, and, on the adoption of that most beautiful and efficient system, the nuisance practically ceased; but to this day the companies are charged with every nuisance that is found in the neighbourhood of their works, as a legacy from the use of lime in days gone by. In those days, also, the greatest difficulty was found in disposing of the spent material, but how it would be got rid of now is beyond my comprehension.

In conclusion, I say without hesitation that any practicable means for removing these sulphur compounds will be gladly adopted, and any one who can suggest such a plan "shall have a fair field and *some favour*." But until this question be solved, let all agitation as to fixing of this or that maximum cease, out of common fairness and justice to the companies. The referees have to determine that point, and if they—thoroughly conversant with the subject, as evidenced by their masterly report, and after long and most searching investigations, investigations still in progress—are not yet in a position equitably to determine a maximum above which the companies shall be liable to heavy penalties, I ask, Who is? G. LIVESEY, *Engineer.*

South Metropolitan Gas-Works, Aug. 26, 1870.

Parliamentary Intelligence.

HOUSE OF LORDS.

(*Before Lord* WALSINGHAM, *Chairman; Viscount* POWERSCOURT, *Lord* SALTERSFORD, *Lord* DUNSANY, *and Lord* HEYTESBURY.)

BLACKBURN CORPORATION IMPROVEMENT BILL.

(*Continued from page* 619.)

WEDNESDAY, JUNE 22.

Mr. *J. S. Whitehead*, examined by Mr. VENABLES.

I am secretary of the Blackburn Water-Works Company, which was incorporated in 1845. They had another Act in 1861. Our supply is from the watershed of the river Darwen. The water with which we are supplied does not come at all into the Blakewater. It comes into the Darwen at Over Darwen. It is the only supply to Blackburn. When we were empowered to take that water there was a provision that there should be a compensation for millowners. A compensation reservoir is constructed, out of which 5 cubic feet per second for 12 hours of every working day is given. We give that in accordance with the requirement as an equivalent for taking the whole of the water in our gathering-ground. Sir William Fielden is one of the millowners who is compensated. The Darwen is a much larger stream than the Blakewater. Our company are entitled to take the whole of that water, having compensated the millowners, consequently if Sir William Fielden gets any water which has passed through the sewers from us, it is in addition to the full compensation which he got for the water abstracted.

Cross-examined by Mr. MILWARD: The Darwen water having been used for the purposes of Blackburn, is discharged into the Blakewater. If we had not abstracted it from the gathering-ground at Darwen, it would have flowed down the Darwen. Sir William Fielden's mill is below the junction of the Blakewater and the Darwen, which is below Blackburn. It is therefore the conjoined waters of both rivers that work the mill. All the water that the company deal with would have come past Sir William Fielden's mill, whether we touched it or not. It would have gone into the Darwen, and so over Sir William's field. I cannot tell how much water will be abstracted from passing over Sir William Fielden's field. All the sewage water will be taken away, and that for flushing the sewers.

Re-examined by Mr. VENABLES: It was calculated that Sir William Fielden and the other millowners got full compensation for all the water we might take to Blackburn.

Mr. MILWARD said he disputed this point, and submitted that the matter had better be argued on the Act of Parliament.

The CHAIRMAN said there was a point which had not been cleared up—that the former compensation to the millowners was for taking a certain amount of water; the promoters proposed now to take more, and that therefore the former compensation did not cover what was now proposed to be taken away.

By the COMMITTEE: Will there be more water taken now?

Witness: The water-wheel supplying Blackburn is compensated for before we take the watershed.

Mr. VENABLES said that the promoters of the bill were entitled to take the whole water from a given area, in consideration of which compensation was given. Incidentally the millowners got the advantage of any waste water from the promoters, but the promoters were entitled to consume the whole of it.

Mr. MILWARD contended that the water which was diverted came back before it reached Sir W. Fielden, and that the present proposition was to take that water from him. Sir W. Fielden's mill was below the junction.

Mr. *Edward Garlick*, examined by Mr. MICHAEL.

I am a civil engineer, surveyor, and land agent at Preston. I am engineer and surveyor to the Corporation of Preston, and to the Ribble Navigation Company. I know the whole of the river Darwen, and the estate of Mr. Petre, of Salmesbury. It contains about 2000 acres. It is divided into sections. The turnpike road goes through it. There are two watersheds—that of the river Darwen, and that of the river Ribble. The latter lies to the north of the turnpike road, and is not interfered with in this bill. The land of the Darwen watershed slopes towards the river Darwen, and is the land proposed to be taken for the irrigation works. It contains about 650 acres. It is only poor agricultural land. It would let at an average of perhaps 20s. to 30s. or 35s. an acre. A few acres only have been planted. There are woodlands alongside of the steep parts adjoining the Darwen, which we call "cloughs." Some drainage has been done, but I do not know how much. Any improvement effected by Mr. Petre would come back to him in the purchase-money. I do not think this land likely to be used for building. I fancy no one would think of building along this valley of the Darwen. It is what you may term a "sink," and in the neighbourhood of Pleasington people are leaving their houses on account of the stench from the river. Even if that nuisance were removed the land would not be likely to be let for buildings. The nearest railway station—Horton station—is two and a half miles. It is about five miles from Preston, and four from Blackburn. These works would be an advantage to the other portions of Mr. Petre's estate by bringing manure into the neighbourhood. It is now a long way off to cart from Blackburn or Preston. I do not think the land taken is in excess. I think the soil is suitable for sewage irrigation. This scheme will cause little severance. There is a small severance near to Roorch, and there is a little in another part. Where it occurs it is in connexion with roads. There is no injury by it, but if it were so it would be compensated. I think the estimate sufficient to carry out the works. I think the irrigation scheme the best that can be adopted, and that the land is the most suitable. I have seen Sir W. Fielden's mill. He was running four pairs of grindstones when I was there. I should not call that a large mill. By this scheme he can take any sewage from the conduit. It cannot be otherwise than an advantage to the proprietor of the land to have an opportunity of benefiting his land by sewage.

Cross-examined by Mr. RODWELL: The soil in question is satisfactory for the purpose if enough of it is taken. I think they will want more as soon as they have tried this scheme. They will then, perhaps, require some more of Mr. Petre's land. I have seen the lime process at Blackburn, and the settling-tank system at Cockermouth. I have read the reports of the Pollution of Rivers Commissioners.

Mr. RODWELL: Dr. Frankland, at page 96 of the report, says: "The getting rid of suspended matters is a simple problem compared with the removal of organic matters *in solution*. It is here that the different processes experience the most severe trial, and it is on the application of this test that the great superiority of downward intermittent filtration and of irrigation over upward filtration and the chemical methods of treatment becomes strikingly apparent. Thus, in round numbers, it may be said that, on the average, the processes of downward intermittent filtration and irrigation remove from the soluble constituents of sewage (as measured by organic carbon and nitrogen) twice as much polluting matter as that got rid of by the process of chemical treatment and of upward filtration. . . Looking only to the purity of effluent water, it would be difficult to decide between downward intermittent filtration, on the one hand, and irrigation on the other." Will you explain to their lordships what that system of downward intermittent filtration is which is compared with irrigation?

Witness: I should say that it is the same as irrigation, to a certain extent If I understand the term literally, the downward intermittent filtration is the settlement of the water through the soil, and it is the same as irrigation. The A. B. C. system is alum, blood, and clay, and it is a failure. The high road between Blackburn and Preston is one of the best roads in Lancashire. It is of a good width, but there is a very steep incline. As far as frontage is concerned, it is a good position for building land. Irrigation would neither attract people to live there nor drive them away if properly carried out. I could not detect any smell from the works until I was within 100 yards. There are hundreds of places in Lancashire built on now, where 20 years ago there was not a house. I think every town with a population of this kind ought to have sewage irrigation works. I am not surprised to hear, taking this as a basis, that 42,000 acres would be required in Lancashire.

Cross-examined by Mr. MILWARD: There are six pairs of stones capable of being worked at Sir William Fielden's mill in flood time. It is not a large mill. It is quite close to Feniscowles Hall, the mansion of Sir William Fielden. We propose to divert the sewage across the country away from the mill. Sir William's mill will be the worst, but it all comes to a matter of compensation.

Mr. VENABLES said that if it should turn out that, under the words of the General Act, Sir William Fielden was not entitled to compensation for his loss, if any, they would be perfectly willing to let him have a special clause to give him compensation for his loss, if any.

Re-examined by Mr. MICHAEL: The corporation cannot force a landowner to take their sewage; it is a matter of mutual agreement. It is a great advantage to the millowner that, instead of a stream of water coming down violently, and often without being of any use to him, there should be a compensation reservoir, from which day by day a certain increment of water is supplied to his mill. That is the operation of the compensation clauses which have been inserted. The millowner gets the advantage of the water being continually supplied to him at a rate he can calculate upon, instead of being liable to all the contingencies of nature, which are often rather injurious than beneficial.

Mr. *George Hunt*, examined by Mr. VENABLES.

I am a land agent at Preston, and the secretary of the North Lancashire Agricultural Society. I have had the principal management of about 65 acres of sewage irrigation in Northumberland for some two years. I do not consider this land is so well adapted for the purpose as that of a more porous nature, such as a sandy soil or moss, but it is very fairly adapted. I believe the work could be advantageously carried out with proper appliances. I do not think there is anything in the land proposed to be taken that would render it difficult to assess the full value of it for the purpose of compensation. I am unable to see any mode of relieving Blackburn so effectually as by irrigation. The Eccleshall Brook joins the Darwen. No sewage from Blackburn could possibly get into that brook, as it is higher up than the watershed.

Cross-examined by Mr. LITTLER: I do not say that irrigation should be extended to every town. It would be a benefit generally where it could be properly applied, and where a better remedy could not be found. The value of sewage as a fertilizer will depend very much upon its strength. I think the Blackburn sewage is sufficiently strong to be highly advantageous. If this sewage is only 1 to 8 as compared to Croydon, it would be a very material matter to consider whether irrigation was desirable or not. Mr. Petre has some beautiful sites in the valley of the Ribble. I have offered to sell similar sites, and have been unable to do so, but no doubt the market value will increase. With regard to Mr. Petre's estate and buildings out of Preston, I understand his former agent would not sell land at all. There is no land selling on Lady Shelley's or Mr. Shaw's estates. There is neither demand nor supply of land. Mrs. Colonel Crofton's property is about 30 acres. It is a detached piece. It has not been in the market, but no objection is raised to its being taken by compulsory powers.

Re-examined by Mr. VENABLES: The nice sites I alluded to are on the banks of the Ribble. They are not within 500 or 600 yards of the land proposed to be irrigated. The turnpike road bounds this road for about a mile. I understand that Sir Henry de Hoghton has been wishing to sell sites. I am not aware of a single villa being built on his estate. Sir Thomas Hesketh has an estate intervening between this and Preston, for sale, but building goes on there very little; there are simply a few straggling houses.

Mr. *Thomas Bertwhistle*, examined by Mr. TAHOURDIN.

I am a land agent, surveyor, and valuer. I have had considerable experience as a valuer, and have had charge of estates for building and other purposes. n am acquainted with the land proposed to be taken by the Blackburn Corporatiol for irrigation purposes. I think it would be much improved if the scheme were carried out. It requires draining. It is the best site that could possibly be taken for the purpose. I agree with the previous witnesses as to the value of the land for building purposes. I do not think the acreage taken is excessive. I consider the estimate sufficient.

Cross-examined by Mr. LITTLER: I have not gone through the whole details of these works. A good deal of the ground may be uncommonly stiff.

Cross-examined by Mr. MILWARD: Sir W. Fielden's mill is nearly new. The machinery is well calculated for the use of all the water power that passes by there. If they are short of water now, if they take a large quantity away it must affect them. The only way that could be avoided would be by using steam power, which would involve the erection of a steam-engine close on the pleasure-grounds of the hall.

Re-examined by Mr. VENABLES: There are millowners on the Eccleston Brook, and they cannot possibly get any of this sewage water. When the second compensation reservoir is finished—the land is purchased for the purpose—the water company will turn down 6 feet per second. They are bound to give exactly the same compensation to the Eccleshall Brook millowner, who has no sewage water, as to the Darwen millowner, who gets it; consequently the compensation must have been intended to apply to the whole of the water extracted.

Mr. *John Cooper*, examined by Mr. VENABLES.

I am the owner of land immediately adjoining the proposed irrigation fields. I have no objection to this scheme coming close; it will improve the land by giving us facilities for getting manure. Generally speaking, the farmers have had to cart the "black muck" from a long distance. It is unpleasant stuff mixed with cinders. I am surprised at any opposition to the scheme. I should have thought it would have been an advantage to every acre in the place, and that Mr. Petre would have been glad to facilitate it. I should as soon think about building a villa at Dartmoor as there. There are no buildings but very inferior small farms. There is no road to it that any two carts can pass except the main road, and that does not touch this land. It is also very ill supplied with spring water. The best soil in Salmesbury is in the Ribble valley, which this scheme does not touch.

Cross-examined by Mr. MILWARD: I have smelt the sewage, but do not care about it. We went for an injunction to the Court of Chancery to stop the sewage fouling the streets of the town, because the stink was so bad.

Cross-examined by Mr. LITTLER: Some of the roads on Mr. Petre's property are amongst the worst in the neighbourhood. We obtain our water from the natural drainage of the soil that comes out in a pipe. There are, perhaps, one or two wells.

John Chalmers Morton, Esq., examined by Mr. VENABLES.

I have been acquainted for many years with nearly all the places where the system of sewage irrigation goes on. I have edited the *Agricultural Gazette*. I had the management of the sewage works at Barking for two years, and I laid out the land for them. Sewage smells offensively whether in tanks or carriers, but as soon as it is distributed over the land it ceases to smell. I have been over the Lodge Farm at Barking at all hours of the day and night, and I never smelt the farm a field off. I have smelt the carriers as I went past them. If you stood to the leeward of the tank you would smell it 30 yards away. I was on the Rivers Pollution Commission. Our business was to ascertain the facts with regard to all possible means of purifying filthy waters. Such means as were not necessarily offensive in themselves were preferred to others. Irrigation on that ground is to be preferred to all others that I know of. I prefer irrigation to the intermittent system of downward filtration, because, being as efficient as the latter, it is accompanied by the conversion of filthy stuff into useful and saleable material. In the summer the effect of the irrigation sewage matter is principally got rid of in the form of vegetation—out of the drains in which all of it would go if it were all submitted to the filtration system. Some of it is wasted, and some of it is con-

verted into non-polluting material, and, being soluble, finds it way through the ground; but still a large portion of it is converted into the material of a growing crop. In the winter it is virtually downward intermittent filtration, on a scale and conducted in a way which is necessarily superior to anything possible where the tank only is the machinery to be used. The plans for precipitating portions of the sewage by chemical preparation do not effectually relieve the pollution of rivers. The result of the A. B. C. system is that, by the addition of clay and alum, that which would take place naturally in the way of subsidence is a good deal facilitated and hastened, and the water, when the process is properly conducted—as it is in a laboratory experiment, for instance—becomes clear to the eye. It is still, however, a polluting material, and still nearly as good for irrigation purposes as before. The solids which are retained are the valueless part of the sewage. In the sewage as it is delivered at the exit of a system of town drainage there is about half a ton of solid material, which has been rattled through those drains mixed up with 1000 tons of water, and during that process it must have become nearly exhausted of its solid material, and it is virtually worthless. In the A. B. C. process a pound of clay and alum and other materials is added to a ton of water, which itself contains rather less than a pound of this sediment, and it is to that extent diluted. It is rather worse in respect of its clay, and it is, perhaps, better in respect of the slight power of precipitation that alum possesses in soluble matter in sewage. I have seen the land proposed to be taken by the corporation, to which there is no opposition. It is well suited for irrigation. Some of it is rather stiff. Mr. Petre's land is perfectly suited. It is not a stiff clay soil. It has a sufficiently good porous subsoil, and it would drain perfectly well if drained with drains from 12 to 15 yards apart, and 4 feet 5 inches deep. This kind of irrigation is best adapted for growing succulent crops for watery growths. It would grow grass. The grass would feed the cattle, and the cattle would give milk.

By the COMMITTEE: It is also good for growing cabbages and mangold-wurtzel. It is perfectly well adapted for growing cattle feed. I have no doubt, from my experience at Barking, that every thousand tons of sewage would produce a ton of milk. There is no foundation for the rumour that milk produced from cows on sewage land was unhealthy for use. I believe an acre of land will cleanse the drainage of more than 100 persons where it is properly worked, accordingly 800 acres would be sufficient for the population of Blackburn. I believe the quantity of water supplied to Blackburn is 1,400,000 gallons a day. According to returns made to us, I think 600,000 gallons of subsoil water got in in addition. If it all got into the exit-pipe it would bring about 8000 tons of sewage. That would go over from 20 to 30 acres a day. It is a mistake to suppose that when a large area is taken for sewage irrigation that it is to be all swamped. There will not be, in this case, 30 acres of sewage irrigation at once. It will pass to one piece of land, and then to another when enough is put on one piece. There would be long intervals, and the land would be aërated. That justifies one in saying that irrigation is the best possible system. In the case of the intermittent downward filtration, you have acted on the filthy water very much as a lung acts on the venous blood; the bulk of the material is charged with air, and this filthy water is aërated, and a process of oxidation ensues, which converts the filthy stuff into a non-polluting material. It is thoroughly oxidized; it is no longer subject to change, and it may be discharged into the water without creating a nuisance. You only irrigate for about five hours. You put 400 tons in about that time. The sewage of Blackburn amounts to 8000 tons during the 24 hours, perhaps 6000 during the day of 12 hours; that is 600 tons per hour. You cannot very well irrigate more than 10 acres at a time with that quantity. You keep it on four hours, and then shift it into another field. The nuisance would be nothing. I have taken the quality of the sewage into consideration in forming my judgment of what the effect would be. I calculated that about 3 or 3½ of ordinary sewage would contain 7 or 8 of fertilizing matter. I mean what a chemist understands as the content of nitrogen in a 100,000 parts. Applying that over the quantity which gets into the river from Blackburn, you have 100 tons of ammonia per annum, and that is equal to 700 or 800 tons of guano, which is certainly a sufficient dressing for 1000 acres of land. It is five or six times an ordinary dressing of guano. I think the land must have a very small residential value indeed. The whole of the upper portion gives the impression of a bleak, unkind, cheerless sort of place. The trees are all stunted, from being exposed to the sea breeze I suppose.

Mr. RODWELL: Will you compare the probable nuisance from the sewage irrigation works and from the collection of sewage in the Darwen, which would be the alternative?

Witness: I suppose the alternative to be this system, and that of downward intermittent filtration; and supposing the laboratory result could be realized on a large scale, in order to cleanse the waste from 2000 or 3000 people, you would want two acres of filth, 6 feet deep, which would have to be charged and drained alternately. That would be two acres of filthy surface, which no doubt would cause a nuisance. It is an acre to about 2000 or 3000 people—that is to say, supposing a small laboratory experiment can be realized on a large scale. It would require 40 acres for 80,000 people. The fluid would be cleansed by depositing its solids on the filters. The solids would be offensive, and would be of very little use. There would also be the liquid surface, and to that extent that it would be at once thrown on the old rotten stuff, and it would set up a rapid fermentation, and be much more liable to create a nuisance than simply surface sewage. That is not the case with irrigation, probably because in the latter system it sinks to a certain extent, and almost immediately grass grows on it. The sewage works at Blackburn do not stink so badly as the Blakewater River a mile below the sewage works.

Cross-examined by Mr. LITTLER: I agree with that part of my own report suggesting the combination of the chemical method with the intermittent system. I think it would diminish the nuisance.

Mr. LITTLER: Should you be surprised to hear that in the work at Hastings, which is disposing of the sewage of 30,000 people, that, with the exception of a slight smell of sulphuretted hydrogen in the drying-house, there is no smell whatever?

Witness: I should be surprised to hear that. I have seen the works at Leamington, and there is great complaint made. We were there 36 hours, day and night. Granting that there would be no nuisance by the process there, you destroy, in a very elaborate and expensive way, a valuable product. It is not a fact that every instance collected in our report shows this product as either a commercial failure or insufficiently profitable to be worth the expense. At Norwood they make £25 an acre of their grass.

Mr. LITTLER: At page 85 of the Rivers Pollution Commission Report you give the total amount received for the produce in the year as £741, which, after deducting the expenditure, leaves a balance of £148. That is the whole of the balance.

Witness: On 30 acres of ground that is pretty fair, I think. I cannot tell the total cost of everything that is fairly applicable to the expense of carrying the sewage for irrigation to Norwood. Worthing is not a good instance to quote in favour of the profitableness of sewage irrigation. It depends a good deal on its management. Several farmers at Barking took small quantities of sewage land. I think it was chiefly to Italian rye-grass they applied it. I do not know that in Warwick they send hundreds of tons of Italian rye-grass to the manure heap. At Warwick you will find the very best and the very worst examples. You will find a perfect success and a perfect failure. It is not possible to doubt that the excrement of a well-fed animal like man is of considerable value, but it is possible to kill a plant by sewage as well as in other ways. Diss has been in a local board's hands the last four years. There they have to pay £1600 a year before they can get any profit. In the Blackburn case there may possibly be a nuisance at first. I should say the remedy must be this: there must be a gradual improvement at the outfall, and the only proportion, which can be used properly, should be brought in increasing quantity as the land extends. The local board must determine how to ensure proper management. They must employ men who are able to deal with it. The whole question as to how to deal with sewage is in its infancy. The neighbourhood of Blackburn is of a low temperature. It is probably better adapted for sewage irrigation in summer than in winter. In the winter, when the water gets solid, there is an end of it. In our report we take samples of what the land can do when bound up in frost. It will do a good deal even in that condition, and is much better than the A. B. C. process. The top of this soil is a brownish-blackish soil—adhesive loam, if you will—for nine inches, but it is not clay. Then it is a mixture of sand and clay and stones. The greater part of it is not so stiff as the Norwood soil; it is better in temperature. A frost would form a coating at the top, and the water trickles beneath. The possibility of a frost stopping all movement is very slight. I would not object to a rainfall of 42 inches. A moist climate is better for growing Italian rye-grass, even with the advantage of sewage, than a dry climate. At the Barking farms I have smelt the fields when a flood has taken place immediately after a drought. During the drought the stuff had got festering in corners; that was all swelled out rotten filth, and smelt so offensively that even the wonderful power of the soil failed for a time. That occurred twice in two years. I admit that occasionally the tanks and carriers smell.

Re-examined by Mr. VENABLES: A frost would be to some extent corrected by the natural warmth of the sewage. I have no doubt the corporation will get a profit rent of £6 an acre, or £6000, which would be a very large interest on the proposed £40,000 for works.

By the COMMITTEE: Would it be worth any one's while to spend £189,000 to get a profit by applying the sewage of Blackburn?

Witness: I should think that there would a be profit rent of £6000 or £7000 *plus* the rent, which, on the assumption of a fair purchase, would represent the capital and some of the land. If you have a fair rental justifying the purchase, you have *plus* that £6000 or £7000 a year to recoup that other expenditure.

By the COMMITTEE: On £190,000?

Witness: That includes the purchase of land, and suppose £140,000 is repaid by the ordinary rental of the land, then there is a profit rent that comes against the £40,000 or £50,000. Land which is covered with a growing crop is more likely to return the sewage than fallow land, because, in the latter case, you have a perfect filtration and aëration, and you have this principle on a large scale, and more likely to succeed than in the case of small tanks. I would apply the sewage while the plant is growing. Mangold-wurtzel, and all succulent growths, are wonderfully increased by that means.

The COMMITTEE: How would you apply it?

Witness: It would spread itself. By having carriers on a ridge, the land being covered with mangold-wurtzel, grass, and cabbage, the water would trickle down among the roots and feed them, and the growth would be enormously greater than anything known to English agriculture of any other kind, so much so that farmers do not believe it.

By Mr. RODWELL: When I first put down the Italian rye-grass, weeds and groundsel came up, but I never saw them again. As soon as you put on the sewage grass it comes up and chokes everything.

By the COMMITTEE: Root growths must be cultivated as they are in ordinary farming.

William Hope, Esq., examined by Mr. MICHAEL.

I have for many years made the utilization of sewage a special subject of inquiry, and have written a large number of pamphlets upon it. In 1861 I made proposals to the Metropolitan Board of Works for the utilization of the sewage of the northern part of the metropolis, and in 1864 they were accepted. I obtained an Act of Parliament in 1864 and 1865 conferring the necessary powers for carrying out my contract with the board. It was referred to a select committee, who made a report, in which they said: "Your committee are of opinion that the scheme is a useful and profitable mode of applying the sewage of the northern parts of London, and they have reason to suppose that no more useful and profitable scheme could be devised." The principal of that scheme was the utilization of sewage by irrigation. A company was incorporated under that Act, in which my rights and property in the sewage were transferred. The history of that company is not a pleasant one. In 1867 I went to reside in Essex in order to watch the proceedings of the company, with which I was very dissatisfied. It was at the experimental farm at Barking. In 1868 I myself got a supply of sewage from the company for about 9 acres of land. That was insufficient for my purpose. The company, with a view to neutralize the result which I should obtain, supplied the sewage in such a way that I could very often make no use of it. In order to checkmate them, I leased a neighbouring farm, together with a lease of the Romford sewage to use on it. I am under a contract to take the whole sewage of Romford. My farm is 121½ acres in extent, for which I pay £300 a year. At present I have the sewage of 6000 or 7000 people, for which I pay £600 a year, but shall eventually have that of 8000 to 9000. I have covenanted with the Romford Local Board to save them from nuisance or pollution of river by means of the water. An injunction had been obtained against Romford by the neighbouring inhabitants on the ground of the nuisance and the pollution of the river Rom, and I have taken on my shoulders all possible damage of that nature. Absolutely no damage has accrued since my undertaking it, and there has been no complaint of any kind. My plan has been that of irrigation pure and simple. £600 is equal to 2s. per head on a population of 6000, but on the eventual population, of course, it will be much less. As to the value of the sewage, I believe it is generally agreed that the market value of the ingredients is about 8s. or 9s. per head. Taking 6000 inhabitants, I should have to pay 8s. or 9s., which would be something like £6000 a year. I have studied the conditions of infection and contagion. Dr. Spencer Cobbold opposed my original proposition to the Metropolitan Board six or seven years ago, on the same grounds as those which have latterly been trumpeted abroad as if they were quite new. I refer to the imaginary spread of parasitic disease by irrigation—the spread of the ova of entozoa. The hypothesis is that the ova of tape-worms would become attached to the vegetation which was irrigated by sewage, and that there would be a progressive increase in the diseases which were generated by the ova of those parasitic animals being taken into the human system. One of the witnesses, before a recent committee of the House of Commons, who supported that theory, stated that if the ova of the tape-worm were taken into the stomach they would reproduce tape-worms. That is wholly incorrect; they would do nothing of the kind; they would reproduce an alternate generation of hydatids, which is a very different thing. It is another form of parasitic animal, being in fact a bladder of water enclosing a small animal in the centre or at the side. They are, in fact, progressive developments of disease, assuming first of all that form, and then going up to the higher form of the anthelmints.

By the COMMITTEE: These hydatids turn to tape-worms in the next generation. The hydatid form of the disease is chiefly seen in sheep and ruminants.

By Mr. MICHAEL: There is no evidence that those animals have become affected by those diseases through eating sewage-grown food. There is no positive evidence published in support of the theory of trichinoid disease. The cows of Edinburgh have chiefly been feed on grass irrigated by the sewage in the summer time for something like two centuries, and if Dr. Cobbold's theory were at all true, such an amount of disease would have spread in Edinburgh, that the original race of inhabitants would have disappeared from the face of the earth. That kind of disease is so frightful, and its effects so apparent, that it must have at once become known had it manifested itself. There have been cases of animals having a certain form of measles, which, by eating the raw flesh of such animals, might be generated in the human being. Beyond that, science has dis-

covered no evidence of the disease. There is certainly none traceable to sewage irrigation, either on the large farm at Barking, in the occupation of the company, or on my own land at Plaistow, or in the new farm at Romford. There have been grown 38 different descriptions of crops and roots, all with perfect success. Better results have been obtained than could have been obtained with any other known mode of agriculture. I know about seven acres of onions growing on a piece of land which was irrigated with sewage during a very hard frost last winter. It is still growing. Steam arises from sewage water as it flows through the carriers, and that indicates a higher temperature than the atmosphere, so that one of the beneficial influences of sewage water is that it has a specific heat greater than the earth it is poured into, and that specific heat in frosty weather is very valuable. Frost has commonly a beneficial influence upon the sewage which falls upon the land. Fallow land has to be irrigated just in the same way as the larger portion of the farmyard manure all over the country is carted out on to the fields when the weather is frosty. The manure is recovered in the following growing season, but the extra benefit of the water is lost. It is, in truth, an intermittent system. There is not a continual soakage of the land, but as soon as the land has taken up a sufficient quantity to fertilize the crop growing upon it, the sewage is transmitted by the carrier to another portion which is fertilized. I do not allow water to run off the land, but send it right through; therefore there can be no accidental pollution of the water by the direct influence of the sewage. If land is properly laid out and managed it should be merely moistened with sewage at any one time, and should receive only just as much as the ground and the crop together can utilize and deodorize. The effluent water which flows off must be, if properly managed, perfectly pure. My land is drained 6 feet deep, and it is not the sewage which goes on it which at once runs through the land, and runs out as effluent water, but the water in the subsoil is drawn out by the superlatent water employed. With regard to the cattle plague and the influence of the sewage water, in 1867 the Metropolis Sewage Company had upon their Barking farm some 250 cows, and they showed symptoms. I asked permission of the Government inspector to treat one half of them if he would treat the other half. I put them in two sheds surrounded in every direction by sewage, to a distance of two or three hundred yards. I treated them chemically with carbonic acid and fumes of sulphur, and the result was the saving of them, whereas the professor lost the whole of the other half. Those that died were not surrounded by sewage. So far as the sewage had any influence, one way or the other, it was beneficial. It did not propagate the disease, as the cows were fed upon sewage grass the whole time. Among the things I have grown more successfully on irrigated land than on ordinary land are wheat, oats, barley, rye, maize, flax, canary seed, Italian rye-grass, Brown's odoratus clover, peas, beans, French beans, scarlet runners, brocoli, mangold-wurtzel, beet-root, parsnips, potatoes, onions, Jerusalem artichokes, parsley, currants, gooseberries, &c. Sewage produces, at first, the finest possible crop of weeds, but in proportion as they are stimulated so the land is cleared of the seeds. As the sewage does not contain any fresh seeds, after a year or two irrigated ground will show less weeds than if cultivated in any other form, because, in the ordinary farmyard manure there is a large quantity of weed seeds. The Metropolis Sewage Company are now growing upon their experimental farm the fourth crop of wheat in succession upon the same piece of ground—a poor, shingly, nasty piece. It is greatly superior to the first crop, and is probably the finest crop in the county.

By Mr. MICHAEL: I agree to the report of the British Association Committee when it says: "At most places the application of the sewage to land has been found to exercise a most beneficial influence upon the condition of the streams and rivers receiving the drainage of the district." Also to this: "Generally speaking, no objections appear to have been made to the application of sewage for irrigation, and where such objections have been urged on the ground that the application was offensive and injurious, they do not appear to have been supported by medical authority, and in several instances they have ceased." I agree with the general principle that as regards the sanitary conditions of these districts it appears that, in most cases, sewage irrigation has not caused any apparent change. I recommended the Metropolis Sewage Company to bring up pure sand for the purpose. I did so in consequence of an attack on my views by Baron Liebig, who said that no land-plant could grow in a medium like sand, to which the nourishing element was supplied in a state of solution; and, as part of my scheme for London was to utilize the surplus portion of the sewage upon Maplin Sands, I suggested an experiment. We brought up sand taken a mile and a half out at sea, and spread it 2½ feet deep upon a measured acre of land, which happened to be an old brickfield beaten hard, and therefore contained nothing for assisting the growth of crops in any way. We have grown 22 or 23 different kinds of crops upon that land irrigated by sewage alone. I think the composition of the soil in the present case leaves nothing to be desired.

Cross-examined by Mr. RODWELL: With regard to tape-worms, &c., my opinion differs from Drs. Cobbold and Letheby. I am not a chemist or a medical man, but those gentlemen are not sewage farmers. I entered on my farm in September. I have no balance-sheet of it yet.

Mr. RODWELL: Do you concur in this portion of the report put into your hand by my learned friend: "It would be premature at present to venture on any conclusions as to the numerous questions arising in reference to the treatment and utilization of sewage, or even to trust implicitly to the figures, &c., given. Even on the assumption that the information furnished to the committee does fairly represent the whole of the circumstances to be considered, that information presents so much variation and even discrepancy in several important details that it seems indispensable there should be, in many instances, a minute investigation upon the spot, which the committee has not yet had power to make." Do you agree with that?

Witness: That report is founded upon information which came officially to the knowledge of the committee. The Maplin Sand scheme has got into the hands of certain parties in the City who refuse to carry it out. The public never had an opportunity of taking up my utilization scheme. The whole capital of the company was fully subscribed. The scheme has not been a failure. I intend that it shall be carried out. I disagree with Dr. Letheby's evidence as to measles and trichina—viz., that it is owing to sewage food.

Re-examined by Mr. MICHAEL: The last part of the report, which has been quoted against me, states: "At the same time, the benefit to land, and the improvement in the condition of rivers, to be realized by the mode of dealing with liquid sewage can scarcely be matter of doubt or uncertainty any longer."

Mr. *James Blackburn*, examined by Mr. VENABLES.

I was educated in Scotland. I was first a practical farmer in East Lothian, and I afterwards studied various sciences connected with agriculture in the University of Edinburgh. I afterwards took a farm in Kincardineshire, in which I carried out the principle of irrigation by sewage. I used to liquefy a large portion of manure in order to grow green crops, and I also had a small tract of land under water irrigation. I made myself thoroughly acquainted with the methods carried on at Edinburgh, and also with the manner in which the grass was afterwards converted into butter and milk by the various cow-feeders. It is a mistaken theory, with regard to tape-worms, that the effect could be traced because the grass was turned into meat, and the meat was sent into London. No farmer would convert grass into meat near a town, when he could convert it into the much more valuable shape of milk and butter. It would never pay the rent. The products of milk and butter, upon a given quantity of food, will give a double return to that of meat from the same quantity. I never heard any complaint of injuries to health from the consumption of the milk and butter so produced. Sir W. Simpson, in his last address to his students, says: "When the crops in these islands shall be increased five or tenfold, and abundance of human food be provided for our increased population by our fields being irrigated by that waste organic refuse of our towns, which we now recklessly run off into rivers and seas." Some years ago I took the lease of the camp farm, at Aldershot. It was the worst soil in Great Britain. It was 95 per cent. sand, 3 per cent. of protoxide of iron, and the merest trace of vegetable matter. I took it out of the commons which had been used for exercising the cavalry horses and the artillery. I deep ploughed and levelled it, and got it in a fit state to receive the camp sewage. It now receives the sewage of slightly over 8000 persons. The water supply varies from 170,000 to 200,000 gallons per day, but through the summer it is very scarce. I have seen the statement, with reference to this farm, made in the House of Commons, to the effect that there does not seem to be anything like one-third of the whole quantity of sewage floating over the land. I can only state that the whole of the sewage that comes on to the farm goes over and through the land. I have been at great expense to increase the bulk of that sewage. So far from having any to spare, I have not had enough.

By the COMMITTEE: The area is 89 acres. I have a little more than an acre to each 100 persons. I have 150 or 160 acres altogether, but the land is too poor for use, and would require exorbitant dressing.

By Mr. VENABLES: The river is called the Blackwater. The noxious sewage does not pass from my land into this stream. I absorb and pass over the land all I take, but for eight months in the summer there is really no sewage passing over it; it passes through it. It is irrigated an acre at a time, and when it gets into the feeding channel it passes off to another acre. The great skill of an irrigator consists in not allowing any to pass off for the eight months in the year. The water when it leaves my land and enters the stream increases the proportion of pure water. Colonel Chesney, the engineer officer in command at Aldershot, thoroughly tested it by taking samples below my outfall, and found the water purer than it was above.

By Mr. RODWELL: That was, I think, in November.

By the COMMITTEE: The water supplied to Aldershot comes from gathering-grounds two and a half miles from the camp. That pure water comes on my land in the shape of sewage. It conveys all the nightsoil and other matters from the camp, and passes out of my farm principally as effluent water, which Professor Abel found to contain half a grain of organic matter or ammonia in a gallon.

By Mr. VENABLES: The neighbourhood is unfit for human habitation, not on account of the farm, but because it is a water-logged swamp. I have a report from the Local Board of Health in 1866, stating that the neighbourhood has been much improved by the farm. When our water is at any other level than that of the outfall the inhabitants use it, but they cannot generally do so if my outfall is as low as their land is, but they are always glad to get it; although they complain of any smell, they are always anxious to get it, north, south, east, and west of their houses. My growth of potatoes is generally freer from disease than my neighbours. It is untrue that the veterinary surgeons refused to take my grass. I asked the veterinary surgeon whether he had any complaints of the grass as to food for horses, and he wrote me an answer in the negative [produced]. He also said he had used it with the greatest advantage. I have a letter [produced] from the Comptroller-General of Aldershot, in answer to a statement made by Dr. Letheby, that the military authorities had made an express condition with the contractor that no produce should be supplied them from the farm. It is: "In reply to your note of yesterday, I beg to say I know nothing of the report you allude to, nor have I any intention to refuse supplies raised on the sewage farm, which, had any been issued, would have been addressed to this office from the War Office. I may say it was only a day or two since, the staff veterinary surgeon told me he has used the Italian rye-grass raised on the sewage farm for the last three years, and approved of it." Dr. Letheby, in his examination, stated that his informant was "some military gentleman who knows about the camp." I have also certificates from the Adjutant-General and from Sir James Scarlett to the same effect. The vegetables have never been refused by the contractor, the cabbages being superior to anything grown by any other process. As to the statement of Dr. Letheby that my land is poisoned by excess of manure, instead of an excess I have a deficiency, and the manure when it comes on to the soil is made immediate use of by the vegetables. If there is any sedimentary matter on the land the fine tendrils come up and lay hold of it on the soil's surface. With regard to Dr. Letheby's statement that the water analyzed by Professor Abel did not come off the sewage irrigation land, there is no water that goes off my farm but that which flows under the land upon which the sewage was applied, therefore it represents water which some time or other has acted on the vehicle for bringing down that sewage on to the land, and having deposited the manurial matter in the soil, percolates through, and goes out as pure water. It is not bad water to drink. Three families have drunk it for three years. Mr. Eggar's statement, that upon the land which had been drained from 3½ feet deep the water at the outfall was impregnated by the droppings of sheep must have been made as a general statement. It is certainly attributing the effect to a wrong cause; it must have got into the drains either by a rat or mole hole, or flowed off the surface of the land. The allegation that when vegetation is dormant in the winter there is no efficient power of purification is a decided mistake. I plough up my land roughly, and turn the sewage on to it in its rough state through the winter, and from my deep cultivation my land will absorb 18 or 20 inches deep. I increase the capacity of absorbing surface by the deep cultivation, and the crops grown upon the irrigated land through the winter are of superior luxuriance. This shows that the land acts as a storehouse for the fertility applied to it in the winter. I never kept cows there. Water irrigation is more unhealthy than sewage irrigation, because in the former there is a much larger quantity of water in proportion to the land than in the latter. There is no analogy between fen land and an irrigated farm. In the latter case everything is in a state of circulation, and there is no stagnation whatever. With a farm of 100 acres I would never have more than 1 acre or 1¼ acre at one time under irrigation. The same land would be under irrigation again in about a month, and would not, the day after being operated upon, wet the soles of your shoes. Although I do not keep cows myself, this year there is milk from between 80 and 100 cows, fed entirely on my grass, going into the camp. As to the suggestion that parasitic disease may be traced from sewage-grown watercress, I should think the manure would be too strong to grow them. There is no analogy between watercress and grass. If the parasitic theory had been well founded I should have heard of it at Edinburgh. The statement of Dr. Letheby that ordinary roots cannot be grown on a sewage farm without adding ordinary manure is incorrect. I grow 45 acres of root crops without any other manure. I have used a small quantity of superphosphate of lime, but not this year. I make very good hay. The soil in the present case will do uncommonly well; in fact, I never saw a soil that would not if properly treated. The sewage compares favourably with most places as regards ammonia. They could grow 600 acres of grass every year, and it would take the whole of the sewage. They could grow roots on a certain portion of it. Before the sewage goes on to my own land all solid matter is taken out of it, and that solid matter is almost valueless as a fertilizer. I have applied 100 loads of manure an acre, and it has hardly produced an ordinary crop. You can by an expensive process convert the sewage into a dry manure, which has to be reconverted into a liquid form before it can be applied to manure the land, and while the advocates of precipitation are drying their manure I could produce three or four crops. The only places in this country where you can see anything green now are the sewage farms. If this system were generally adopted wherever there is a dense population, it would very greatly increase the supply of food. Taking the average, I would prefer to apply 20 gallons of liquid per acre per head of the population to the ground. Comparing sewage land with land highly farmed with other manure, the smell of the former is not half so bad as the latter. I am practically of opinion it is an enormous waste not to adopt irrigation works.

It is a national question, and really affects the agriculture of the country and its food-producing capacity. I think every man would prefer to have his field yielding five times the produce it does now.

Cross-examined by Mr. RODWELL: I get my land and my sewage for nothing. My returns exceed the expenses. The land is not worth anything, and is not well adapted for sewage. The better the land the better the results that will be produced with a given quantity of sewage. I would rather pay £3 an acre for good land than get such land as I have now for nothing. The sewage is far better than the London sewage. I am not aware of proceedings being instituted against my farm for nuisance last October. There was an inquiry. The river wanted cleaning out, owing to its pollution by the town of Aldershot, which throws everything into it. A riparian owner, who is a mile and a half higher up than I, brought an injunction against the town, in the Court of Chancery on account of the nuisance. The defence was that any such nuisance would come as much from the camp farm as from the town. They went to the Government, and asked them to contribute towards cleaning out the stream. The Government declined, as they did not consider that they aided in polluting it. The water discharged from my farm is sometimes very black. It has not been so since I left off trenching. I trench four or five acres every year, and when I do so the protoxide of iron becomes tolerably washed out by the liquid.

Mr. RODWELL: Would you call this a correct description of your farm and the state of the sewage—this was on the 1st of May. It says: "As it ran along the carriers to the lower part of the farm it retained its black offensive character, and this was very marked upon that portion of the land where a little of it was distributed. At one of the outfalls of the Blackwater River it contained 52 grains of soluble water per gallon, of which 28 grains were organic and 3·84 grains of suspended matter. At three other outfalls from the farm the soluble matters amounted respectively to 52 grains, 58 grains, and 54 grains per gallon, of which 24 grains, 20 grains, and 22 grains were organic; the suspended matters being 26 grains, 6 grains, and 5 grains per gallon respectively, of which 12 grains, 2 grains, and 3 grains were organic. At the several points of discharge into the river the sewage was black fœtid, and there were large accumulations of sewage mud in a high state of decomposition. I took a sample of the river water before it received the outfall sewage and after; the former contained 19 grains of soluble matter, and the latter 26 grains, of which the organic amounted to 3½ grains and 5 grains, the ammonia in the two cases being 0·264 of a grain and 1·545 grains, showing an enormous pollution of the river by the so-called defœcated sewage"?

Witness: On Sunday, the 1st of May, none of that sewage was going on to my farm at all. One of the men below my farm asked my irrigator for some sewage, as his meadows were burnt up. It was given him, and so on the date in question the sewage was going on to this meadow land, and not on to my farm at all.

Mr. RODWELL: That is on the day when "everywhere upon the land where the sewage had been distributed there were masses of fœcal matter waiting for the first heavy shower of rain to wash them away into the nearest outfall, and the neighbouring ditches were in a most offensive condition, and we were told by the occupants of the houses adjoining the farm that in times of flood the whole roadway was covered with sewage matters." Do you agree with that?

Witness: There is no fœcal matter that goes on my land at all. It is strained through a settling-tank. The land below my farm is very low, and after heavy storms of rain the river comes down and overflows the whole land. You can readily imagine that it brings down the fœcal and solid matter of the town, and spreads its broadcast over the whole country; the water gradually subsides, and it is by that filthy water that the ditches are replenished.

Re-examined by Mr. VENABLES: My farm had nothing at all to do with the offensive condition of the ditches. The Blackwater above my farm is very foul. There are no ditches on the farm. There are stagnant ditches adjacent, which are offensive from the cause stated, and also from the inhabitants throwing all their refuse matter into them. No fœcal matter ever enters the carriers.

By Mr. RODWELL: The Government never spent 6d. on the farm.

By the COMMITTEE: Rent of meadow land near Edinburgh varies from £21 to £40 an acre. I do not trench by spade labour. The protoxide of iron is gradually getting converted into peroxide of iron. I first have a plough, and make a furrow 14 inches by 16 underneath the bottom, and by that means I smash up the protoxide. The protoxide does not colour the land, but it colours the water. I expect to make my farm perfectly clear of it.

FRIDAY, JUNE 24.

Mr. *Robert Railton*, examined by Mr. TAHOURDIN.

I am an analytical chemist at Blackburn. I have been a fellow of the Chemical Society since 1852. I commenced analyzing the Blackburn sewage on the 10th of May, and have continued doing so up to the present time. I have made microscopical observations, and have also examined some soil taken at various depths upon Mr. Petre's estate.

The following table was handed in:—

Determinations of Per Centages of Water and Sand in Subsoil taken from Lands at Samlesbury, scheduled for Irrigation Purposes by the Corporation of Blackburn. Taken on June 11, 1870, *by* R. RAILTON, F.C.S.

No. of Field on Plan.	Depth of Surface Soil.	Depth at which Subsoil was taken from Surface of Ground.	Per Centage of Water.	Per Centage of Sand Calculated from the "Dry Earth."	Per Centage of Sand Calculated from the "Moist Earth."	Owners of the Land.	Observations.
145	12 in.	30 in.	17·14	68·42	56·69	Mrs. Crofton.	In centre of scheme
167	11 in.	21 in.	16·45	79·38	66·32	Mr. Petre.	Taken at about
256	8 in.	15 in.	18·51	88·51	72·86	Mr. Petre.	equal distances
273	12 in.	24 in.	13·70	60·93	52·57	Mr. Petre.	round scheme.

Witness: The samples were taken from places selected solely by me. I find the absorbent powers of the soil to be very good, and the land to be well adapted for sewage irrigation. I cannot agree with the theory that it is likely to produce tape-worm. I used an ounce of lime water to a gallon of sewage matter, and completely destroyed the animalculæ which were in it. The addition of lime water would benefit the sewage water.

Cross-examined by Mr. LITTLER: I should think about 60 or 70 per cent. of sand would constitute a sandy soil. The soil below the clay is stiff. The average of nitrogen in my analyses is somewhere near 2½ per cent. Animalculæ sometimes largely exist in sewage. I have had no special experience of sewage irrigation.

Re-examined by Mr. MICHAEL: The Blackburn sewage is rather weaker than that of Croydon, but its constituents are the same with regard to soluble matter—matters held in suspension and nitrogen.

Dr. *William Odling*, examined by Mr. MICHAEL.

I am a fellow of the College of Physicians, a fellow of the Royal Society, and professor of chemistry at the Royal Institution. For the last 15 years I have paid attention to the question of the ultimate disposal of sewage. The scheme proposed for Blackburn is an excellent one, and with reference to public health and the state of the river an unobjectionable one. Whatever mode is adopted, the sewage water must ultimately come back into the streams or rivers with more or less impregnation. All the modes actually practised may be divided into two—either precipitation or irrigation. I prefer the latter, because it purifies to a greater degree than the other. It also gets rid of the putrescible matter entirely, and the other system does not. By the irrigation system the element of putrescence is in a great measure converted into vegetable life. Irrigation is more economical than filtration. It is not at all necessary that nuisance should attend sewage irrigation. So long as the sewage is taken, and runs over the land, of course it has more or less smell. If it is fresh sewage the smell is slight, if stale the smell is strong. Fresh sewage can only be smelt close to the channels, but as soon as it gets on to the land it ceases to be sewage, and the smell departs. I am unaware of any established case of ill-health resulting to a neighbourhood from this cause. This system does not convert land into a swamp. It is material to the success of this scheme that the land should be well drained. If there had been any cases of entozoic disease from eating the produce of a sewage farm we should have heard of plenty of them. At Carlisle they feed sheep directly on the grass for fattening. Those sheep are perfectly healthy, and have sold well for butchers. Where stale sewage escapes into enclosed houses, where people sleep, no doubt sewage fevers are generated, but where fresh sewage runs simply along an open channel, and over the land when it ceases to be sewage, there have been no fever cases which have stood the test of examination. Different methods of precipitation will purify sewage fit for discharge in some cases, but it will not answer in the present case. Filtration leaves behind a large quantity of sludge, which there is a great difficulty in dealing with. The A. B. C. process is utterly valueless. Solid manure is only worth a few shillings per ton.

Cross-examined by Mr. LITTLER: Leicester is not a satisfactory sample of the average working of the A. B. C. process. It was an experiment made for a special purpose. Precipitation would not do at Blackburn, because the sewage is about 2 million gallons a day, and the river is very small, which is frequently almost dry during the hot weather. The flow of the river is nothing like ten or twenty times the quantity of sewage. No doubt if sewage was first precipitated, and then filtered in the way described by Dr. Frankland, you would get a degree of purification which would leave nothing to be desired; but that process, as far as I know, has never been put into practical operation, and I believe it would be very difficult to do so. I tried to filter the water at Nottingham the other day, but it choked the filter, and they were obliged to use gravel, which is no filtration at all. If in winter the purification is less complete than would be necessary in summer, it is a matter of little consequence. I should not say the fitness of the soil was in proportion to the amount of sand. It is doubtless a difficulty with the water-closet system that the gases get into the houses. I understand the solid sewage would have to be removed from the 13,000 cespools which are in the town. I live three miles from the sewage works at Croydon.

Re-examined by Mr. MICHAEL: I am aware there are precipitating-tanks which will be used at Blackburn if the sewage farm is carried out. In the winter time this will be a system of intermittent filtration with a very large area of filter.

By the COMMITTEE: A rainfall would no doubt dilute the sewage, and carry it into the earth. Clay has the property of absorbing a greater part of the noxious elements of the sewage than sand.

Dr. *A. Voelcker*, F.R.S., examined by Mr. MICHAEL.

I am professor of chemistry to the Royal Agricultural Society. I have given especial attention to the application of sewage to agricultural purposes. I know the principal sewage works from personal inspection. I am sure that none of the plans which have been recommended for completely purifying sewage is thoroughly efficacious, and that none of the various schemes of extracting the fertilizing matters at all answers its purpose. The various schemes scarcely effect anything else but the removal of the suspended matter. Various plans for precipitating sewage effect in some measure its clarification and decolorization, and disinfect it to some extent, but they do not sufficiently purify the water, so that, under all circumstances, it might be discharged into the stream without polluting it. Generally there is soluble matter added to the water by means of the precipitates which are used for effecting the removal of the floating matter. All these processes have been complete failures, both in a commercial and agricultural sense. The value of the manure prepared by the A. B. C. process is generally one-third of the price asked by the company, and in some cases considerably less. The samples are always varying, some contain two and a fraction per cent. of phosphate of lime, which is one of the valuable constituents; others contain scarcely one per cent.; others contain nearly two per cent. of nitrogen (which is classed as ammonia), and others contain only a fraction of one per cent. These variations render it impossible, without analysis, to ascertain what the value of the manure would be. These elements should be constant in their proportion to constitute a valuable manure. Speaking generally, I am of opinion that irrigation is the only efficacious means for thoroughly purifying the sewage, and extracting from it its most practical benefit. The filtration works at Birmingham created such a horrible stench that five actions have been instituted by the inhabitants. I believe that irrigation works may be conducted without nuisance.

Cross-examined by Mr. RODWELL: The intermittent process of filtration is in reality irrigation. At Luton the liquid is discharged into a tributary of the river without going through this intermittent filtration, therefore this intermittent filtration is in addition to what exists at Luton or Hertford. The purification depends upon the filtration and the composition of the soil. In order to be efficacious, the soil must have a certain composition; it must have sufficient of the elements to act chemically on the fertilizing properties of the sewage by retaining them. That is essential. It must also have certain mechanical conditions, which, by reason of its porosity, enable it to hold air, and the combustion of matter. Artificial filter-beds may extract the impurities.

Re-examined by Mr. MICHAEL: Practically the artificial filters have not succeeded. The land becomes an intermittent filter of the best kind, because a large expanse of mould is constantly exposed to the action of the atmosphere. The most perfect soil for sewage would contain a fair proportion of clay, lime, and sand—easy, free-working, and friable land—which is sufficiently porous in wet weather to allow any amount of water to go rapidly into the drains, and which in wet weather does not become podgy, and from which in fine weather the liquid flows away.

By the COMMITTEE: Filtering-beds lose their assimilating effect by use. They have to be renewed from time to time.

Dr. *Edward Frankland*, examined by Mr. MICHAEL.

I am a member of the Rivers Pollution Commission. For the last two years and a half I have been almost constantly occupied with the question of the disposal of sewage. The following is in my report [reading]: "These experiments upon the filtration of sewage through various materials leave no doubt that this liquid can be effectually purified by such processes, and that probably any variety of porous and finely divided soil may be employed for this purpose. Our experiments also appear to show that if the soil be not overdosed with sewage it will retain its efficiency for a long, if not an unlimited, period of time, and its pores will not become clogged up. With a properly constituted soil, well and deeply drained, nothing more would be necessary than to level the surface, and to divide it into four plots, each of which in succession would then receive the sewage for six hours. In this way the sewage of a water-closet town of 10,000 inhabitants could, at a very moderate estimate, be cleared upon 5 acres of land, if the latter were well drained to the depth of 6 feet. . . . Nevertheless there are three formidable objections to the general adoption of

this process. First, it is entirely unremunerative; the amount of sewage applied to a given acre of land being probably in such a case too great to permit of the growth of any ordinary agricultural crop." It would be constantly drenched with sewage for 6 hours out of the 13; it would be covered with sewage, and I believe no crop could grow upon it. "Secondly, the whole of the manure ingredients of the sewage would be absolutely wasted. . . . And thirdly, the collection of solid fœcal matters upon the surface of the soil, with no vegetation to make use of them, would probably give rise to a formidable nuisance, especially in hot weather. We also entertain doubts as to the process being equally successful, under ordinary management, on a large scale, since the sewage would be likely to pass through the land in an unequal manner; in some places reaching the drains very rapidly, in others passing through the soil too slowly." We were led to mention these doubts from the circumstance that our experiments were made in a laboratory, with large glass cylinders 6 feet high, and about 10 to 12 inches diameter. It was obvious that one might get a uniform result in a cylinder of that kind, which is not easy to be obtained in a field with cracks in the soil, and so one might allow the sewage to go immediately into the drains below without coming into contact with the soil so as to change the noxious matters. This system would require 40 acres of ground at Blackburn. That would be an exposed surface of 40 acres continually covered with fœcal matter, and covered for six hours with sewage dry and exposed to the air. I should certainly deprecate this system at Blackburn. I should like it tried as an experiment at some place where irrigation is impracticable, where the sewage of only 2000 or 3000 people is to be operated upon, and where the expense of these filters would not fall upon a large portion of the community as in a large town like Blackburn. I believe irrigation has been used in Edinburgh for the greater part of two centuries, and more recently in a variety of places, and, as far as I have seen, with great success in cleansing the liquid and leaving useful products. The land at Blackburn is about the right quantity. Its situation leaves nothing to be desired. There is no residential injury. A large portion of the land has such a slope towards the river as to permit of the sewage being caught repeatedly and used again—a process which, in the interest of the river's purity, I strongly recommend. Upon plot 167 I found the soil to be a moderately stiff clay, mixed up with some sand upon a subsoil of clay. In plot 168 there were 9 inches of sandy clay, with a subsoil of tolerably stiff clay interspersed with sandy patches. In plot 140 I found a sandy loam 16 inches deep with a sandy clay below it. In plot 28 I found a very sandy loam on pure sand below. I consider the soil in all places where I tried it perfectly adapted for irrigation. A soil which will purify the water to the greatest extent is not always adapted to produce the best crop. In an irrigation farm where you want good crops, you require to have a soil that shall extract the noxious matters out of the sewage and retain them in its pores, so that in the subsequent season the plants may feed upon it. But the more porous and sandy the soil is—supposing the sand to be coarse and not fine—the more complete generally will be the purification of the water. This soil to a certain extent combines both qualities. I am aware there are a great many inches of rainfall there in the winter, but the sewage would, notwithstanding, be discharged into the river sufficiently purified. I have recently, as a Pollution of Rivers Commissioner, again visited Leamington to examine the A. B. C. process, and the result was still more unfavourable. The filtration part of the scheme had been abandoned. That was a supplementary part of the process, which until recently the patentees have greatly relied on, in order to make the water sufficiently purified to go into the river. The system adopted was futile, and we found it blocked up with black putrescent mud, which prevented its going through the filter; they, therefore, depend on the chemical process. It was superadded, and we entertained a favourable idea of the combination, inasmuch as not only the effluent water but the sewage would be purified; but it would require much more extensive filters, and to be conducted upon a much more extensive system. I have made 31 analyses of the effluent water at Croydon, and on every occasion, except one, it was perfectly purified and perfectly admissible into the river without any nuisance. Even upon that one occasion it was very slightly above the standard of impurity which we have mentioned in our report. Last winter, during a severe frost, the samples were quite satisfactory. Thirty samples were collected at Norwood. The soil there is very stiff clay. The effluent water there was very much superior to that produced by any other process practically carried out. I have examined water when it has been purified by chemical means, and it has not been satisfactory. The commission visited Edinburgh and took the evidence of Professor Christison, and of the medical officers of health in the barracks, which were situated in almost the middle of the sewage farms, and they were unanimously of opinion that no injury had arisen from the works at Edinburgh, which are carried on in a very slovenly way. There is no object in purifying the water, but there is merely the manufacture of grass.

Cross-examined by Mr. RODWELL: I am not prepared to say, from the experiments of other than irrigation schemes in my laboratory, that if those processes were practically tried they would be failures. On the contrary, they might be successful. I visited the Farnworth Paper Mills. I found the water there in a beautiful state after being purified by filtration through sand, after a long subsidence in reservoirs. I do not know if there are a million gallons of foul water filtered there per day. It was a practical trial of that system, but it was not sewage. It was the sewage of Bolton mixed with the water of the Tonge—a large river—and the foul water was first submitted to long subsidence. This is not a practical illustration that sewage can be extracted from water otherwise than by sewage irrigation. If this apparatus, which is used by Mr. Rideau, in order to cleanse his water for manufacture, were to be employed upon the sewers at Blackburn, the sewers, in two or three days, would be completely blocked up, and entirely useless, and no sewage would be purified. In February, 1868, in conjunction with Dr. Letheby and Dr. Odling, I recommended, as an alternative scheme, the lime process for purifying the London sewage. We recommended several processes.

Mr. RODWELL: You stated in that report, "That sewage matter can be so purified as to be admissible into the river Thames. That its purification can be effected by the process of irrigation, or of chemical precipitation. That sewage water so purified ought not to exceed the former standard of impurity." Do you contradict the opinion which you gave in 1868?

Witness: In what respect?

Mr. RODWELL (after reading other parts of the report): Therefore, in 1868, you distinctly reported to the Metropolitan Board of Works, who had to deal with the largest quantity of sewage in the world, that it was open to them to deal with one of two causes?

Witness: Yes; those were the results of experiments extending over two months. I have since had an experience of two or three years, and my opinion with regard to the chemical processes has undoubtedly been altered. If I were asked to report to the Metropolitan Board now, the only mode I should recommend, as having the stamp of experience, would be irrigation. I have been to Hertford, and I do not pronounce the system a success. The Londoners, who are supplied by the New River or East London Companies, drink the water into which this purified sewage is turned. I analyze those waters every month. I find them slightly impure, the East London particularly. I complained of it to the Registrar-General. No further steps have been taken in the matter. Higgs's process is used there.

Mr. RODWELL: Why should not Higgs's process be used at Blackburn?

Witness: Because it does not purify the sewage.

Mr. RODWELL: If it is used at Hertford and Luton, and if the water is sufficiently pure for the Londoners to drink, surely it can be done where the water is not drunk.

Witness: It mixes there with a much larger portion of water than at Blackburn. At Blackburn, after mixing with the Blakewater, and with another stream below the sewage, is in a very much larger proportion. I am speaking of dry weather, and am judging from my eye. Higgs's system would not purify the water so as to bring it down within those standards which we have laid down.

Mr. RODWELL: You say, "The previous treatment of the sewage by one of the chemical processes already described would, however, obviate this liability to nuisance, whilst it would probably reduce by one-half the size of the filter necessary for cleansing a given volume of sewage. Such a combination of a chemical method with intermittent filtration offers the most hopeful process, both as regards economy and efficiency, in cases where irrigation is impracticable." If you dismiss from your mind those last words, I ask you if there is any reason whatever why that process should not act at Blackburn?

Witness: There is no reason whatever why it should not act, but if it did not act it would involve a very great sum of money which would be utterly wasted.

Re-examined by Mr. MICHAEL: It is an essential condition, when treating of sewage purification, to consider the quantity of water with which it is diluted. When sewage is concentrated it would be impossible to apply the same means of purification which would be available when it is largely diluted. At Hertford the sewage goes through a long water channel, which contains a vast amount of vegetation that would have a purifying influence. We found the sewage very considerably purified, before it reaches the river Lea, by chemical processes.

Mr. RODWELL: Supposing a gentleman's residence to be immediately contiguous to this green spot [referring to map], would you advise the corporation to place filtration there, immediately under his residence?

Witness: Certainly not; it would be a very risky procedure, certainly. The question as to whether the surface of these filters would not be a great nuisance in summer yet remains to be solved.

Robert Rawlinson, Esq., C.B., examined by Mr. MICHAEL.

I am a civil engineer, and have had considerable experience in sewage and water works. I am the Government commissioner, under the Public Works Act, in Lancashire. I was the Government inquirer for administering the fund of £1,750,000 advanced by Government during the cotton famine. The main sewage works of Blackburn were principally devised by Mr. Brierly. They carried out their works to a certain extent; they passed the outlet into the Blakewater River, and then got into difficulties by polluting the stream. They applied to me, and I put up their present straining-tanks—filter-beds they cannot be called—to see if that would avail them. This, however, has not prevented the pollution from being a nuisance in the river. They were thrown into Chancery, and the Lord Chancellor recommending the delay of the suit until some person should report whether the scheme could be made efficient, I was the person appointed, and I have inspected those tanks several times since. I have informed the Town Council by communication that they could not be permitted to go on, that I found they would not do the work that I myself had anticipated, that they were not calculated to clarify the water, and that the only method I knew by which they could escape the law was by obtaining sufficient area of land and irrigating it; hence this bill. I believe irrigation to be the best scheme. I have inspected almost every place where deposit-tanks have been provided, and where chemical treatment has been resorted to, and I have found that they have not chemically clarified the sewage, and have utterly failed to make a manure of any commercial value. By the contemplated system there would be no nuisance. The slush is at present taken up in buckets, and put into wrought-iron covered conveyances, and so taken away. That system would be continued, therefore no fresh nuisance with regard to solid matter would be created by the proposed works. My attention has been especially directed to the allegations made as to the injury accruing to public health from sewage irrigation farms. I was connected with the Royal Commission appointed to inquire into it. We came to the conclusion that we had no evidence to establish any cause of disease from properly arranged sewage irrigation, and in fact we failed to have any definite fact brought before us wherein proper modes of irrigation had been carried on. We had house-to-house examination in Lancashire, and we failed to find in the vicinity those diseases in excess which are attributable to rivers. As there was a larger area, and a current for ventilation, we came to the conclusion that, foul as the rivers were, there was less disease there than in the other parts of the town, where the houses were more crowded together with less ventilation. I have no evidence that it has caused injury to the public health, not even where it is carried on in the coarsest and foulest manner, as in Edinburgh.

Mr. MICHAEL: There must be some chemical change occurring in sewage before it becomes of this obnoxious quality; it is not the fresh sewage, but the fresh sewage which has become putrescent?

Witness: I assume it must be so. I was the sanitary commissioner sent out by the Government to the army in the Crimea. The Turkish barracks were sewered with great, wide, flat-bottomed sewers, emptying themselves into the Bosphorus. We had 4000 cases of sickness in the hospitals, and the mortality when I landed there in March was at the rate of 80 and 90 per day. The dread was that with heat of summer the mortality would increase. My very second day's operation was to examine those sewers, and to have their mouths covered; the next day to smash out all the top squares of the windows. I broke about 800 squares of glass, and commenced organizing a system of scavenging, flushing, and sewering, and turning the sewage into fresh sewage. At the end of three months the mortality was reduced weekly from 11 per cent. to 1½ per cent., and in one of the hospitals to half per cent. By the end of that summer the hospitals were in a healthier condition than any of the great hospitals of Europe. There would be no unhealthy emanations from a sewage farm exposed continually to the atmosphere. The cows at Edinburgh are constantly feed on sewage grass, and the great milk mart at Glasgow is supplied by some 1000 cows who are fed partly on sewage grass.

Cross-examined by Mr. LITTLER: I cannot give any instance, with the exception of Edinburgh, of any town that has made 6d. out of sewage as a fair return for capital expended. Worthing does not earn half per cent. It is not because it will not do it, but because it has not been properly managed. I do not think Blackburn is bound to look for a remunerative return. It is bound to get rid of its nuisance in the cheapest and best way.

Mr. LITTLER: You think the town are justified in saddling themselves in all that which experience shows to be an expenditure in perpetuity?

Witness: I do. The town would escape from the obligation if you could show them how they could get rid of litigation, and how you could land them in a successful mode of dealing with the question. Sewage, as sewage, cannot be filtered. I should be sorry to see Blackburn attempt the chemical process. It would saddle them with a great nuisance, and a far greater expense. The Luton works are a disgrace. I have felt a palpable smell from a sewage farm, but it was not from the irrigated portion, but from the open carriers, which had been allowed to accumulate matters which had got putrescent.

Re-examined by Mr. VENABLES: There are chemical treatments which leave the sewage water bright, but in that case there is great danger. If chemicals are resorted to, and the effluent water is greater in bulk than the stream into which it is passing, if cattle drink it in this weather, that chemically treated water will affect the butter and the milk, and render both unsaleable. You may filter sewage that has been doctored up to a certain point. If you arrange

your filter for an upward flow, the sewage coats it with a film of flocculent scum: it becomes like a kind of coarse paper. The arrangement that Dr. Frankland described of passing clarified water through a prepared portion of soil, 6 feet in depth, very slowly oxidizing and separating the chemical ingredients from the water, is not filtration in the ordinary sense of the term. It is a new process set up, upon which we both have strong doubts. For £140,000 the corporation will get an estate worth that sum, *plus* the sewage they put on. I believe the £47,000 (for land) laid out upon conduits, under-drainage, arranging it in its surface contours, levelling it, &c., would be money well laid out, and would add to the value of the estate the full sum expended, if not more.

Mr. VENABLES stated that this was the case for the promoters of the bill.

Mr. LITTLER said he would proceed to call evidence on behalf of Mr. Petre, and would address the committee hereafter.

John Drysdale, Esq., examined by Mr. LITTLER.

I am Mr. Petre's estate agent, and am a surveyor practising at Bolton. I have had great experience in converting land from a rough condition into superior agricultural land, and subsequently into building land. Up to the time of my taking the management of Mr. Petre's estate, five or six years ago, it had been managed by some one in London who had merely taken the rents, and had not troubled himself about improving it. He had refused to let any land to build upon. At Danvell, on the other side of Blackburn, Mr. Petre has another estate on which there had not been a building or piece of land let there for 20 years, on account of the agent refusing. The last few years the trade has been more prosperous there, and I have let some 50 or 60 building plots. I have disposed of some here. The property is now beginning to be thought of for building purposes. The Bolton estate was in a much worse state than this. There are three and a half miles of it, in 10 and 20 acre plots, from £10 up to £60 an acre. It has been converted by draining, &c. In the neighbourhood of all large Lancashire towns it is the tendency for people to take houses in a quiet place. On this particular estate Mr. Petre has been gradually spending money in improving and draining it, and has planted many thousand trees. From the condition of things round Preston and Blackburn, this land is in a condition to be brought into the market as a building estate. The roads are exceedingly good. Mr. Cooper's roads are about the worst on that side; beyond the Darwen they are not very good, but on the other side they are very good indeed. We have two roads from Preston, one of which is free from toll. Mr. Cooper said the road was very steep; one is a very slight bank indeed. I do not know a better road in Lancashire. A distance of 2½ miles from one town, and 4 miles from another, would be no objection to the class of persons likely to live here.

By the COMMITTEE: I sell about £500 or £600 a year of timber at Salmesbury, by merely thinning the trees.

By Mr. LITTLER: That land [referring to map] belongs to Mr. Petre, and some of the timber thereon is 100 years old. There are trees worth £10 there. [A number of photographs were here produced.] I sold the Blackburn Water-Works some thoroughly agricultural land at £300 an acre. I do not know any place more likely to be selected for building than this spot [pointing]. I have no doubt that if this land is let alone it will be very shortly in the market. I should think upon one estate alone £100,000 has been expended the last few years. The farming rents are more than they were ten years ago. There is a first-rate salmon fishery there in the Ribble. Mr. Petre goes there every year to fish. He has taken great interest in the estate ever since his father left it him. Now we are completely upset; the farmers are all upset. They come and ask me if I will guarantee their money back again for the land. With the present feeling with regard to sewage farms, I think people will certainly not come and build on the land. I have spent, speaking roughly, perhaps from £1500 to £2000 a year on this estate since I have been agent. My opinion is that this land is too stiff for a sewage farm, and that there is better land in the neighbourhood, I found it very difficult to drain; in fact, I put the drains closer together than usual. I could show any amount of land that could be got for the purpose—10,000 acres at least. The rainfall is 45 inches in the year. During the thunderstorm last Thursday, in two hours we had 2 inches of rainfall. The water goes off the land, but not so quickly as it would off a light, stony, sandy land. It is quite free from stone. Supposing this bill is passed, I should say two years would be quite sufficient for the corporation to consider whether they will take our land or not. It might be carried out in one year. Their taking three years to buy the land is quite absurd.

By the COMMITTEE: They are yearly tenants.

Cross-examined by Mr. VENABLES: The tenants will be entitled to compensation. I should think the owners of the 10,000 acres I referred to would let you have as much as you wanted without opposition, because theirs is never likely to become building land, and ours is. Mr. Harrison has a villa building on the edge of Nab's Head, and he has taken ornamental land in front. The land sold below Roach Mill was not for a villa. The land sold to Mr. Walmisley was not at a building price. I do not know whether you would call the land sold to Mr. Harrison a building or an agricultural piece. I should think it was the former. We should be able to see the sewage farm for 1½ mile along the best road in Lancashire. I do not know exactly how far the slope towards the Ribble goes into the land which you propose to take. We shall be entitled to compensation for the additional value of the land by drainage.

Re-examined by Mr. LITTLER: Whichever way this land slopes it has good views from it. There are beautiful views down the valley of the Darwen. The ground sold to Mr. Harrison is outlying, and does not particularly affect the estate.

Mr. *A. Mowbert*, examined by Mr. LITTLER.

I am agent for some large estates in Lancashire, and have the superintendence of about 20,000 acres of cultivated land. I have known Mr. Petre's estate for the last ten years. I think a sewage farm would seriously prejudice Mr. Petre's estate. It partakes of the character of building land to a very great extent. It has every prospect of becoming a most valuable property between the two important towns of Preston and Blackburn. It is land that is likely to be utilized for houses with 5 or 10 acres within the next few years, and I do not know a better site between those two towns. The promoters will have to pay a very large price for the land, but the probability would be that the landowner would not get full compensation for the injury done to his property.

Cross-examined by Mr. VENABLES: It is very difficult indeed to get a place in that part of Lancashire which is not within a few miles of a large town.

Re-examined by Mr. LITTLER: There are places near both Blackburn and Preston which will never be anything but agricultural land for a long time to come. There is plenty of land suitable for a sewage farm. I should never think of appropriating this property for any such purpose.

Thomas Statter, Esq., examined by Mr. LITTLER.

I am a civil engineer, but I pay more attention to land engineering and surveying. I farm very much myself, and have the management of 20,000 acres of Lord Derby's estates, which embrace every class of property. I have known Mr. Petre's estate for a long period. From the peculiarity of its situation between Blackburn and Preston, I know no property so attractive for residential purposes. It is out of sight of chimneys, it is well wooded, the land is nice undulating, and the roads through the estate are very good. There are certain lands between this estate and Preston that have been tied up for some time. They are not adapted for the purpose that this is, but are more suitable for street property and houses built in rows. The last five years have been unfavourable to manufacturing persons going into larger expenditure. As trade revives there will be a considerable increase of building in this direction. The effect of the sewage farm would, I consider, be a complete destruction of the estate for other than agricultural purposes. I have visited various places where sewage farming goes on. At Edinburgh they have found out that, although their present area of meadows produces a large rental, yet if they attempt to utilize further lands by the application of sewage it does not pay. The sewage there may be smelt a mile off, even at the most favourable period. I know no place where it is a success. At Barking it is comparatively a success. It is there quite deep enough for all operations, and it is resting on a gravel bed 15 feet or 16 feet deep, which is in itself a filter-bed, consequently the soil utilizes all the matter of the sewage, and the water is passed off by a drain, which takes the water to the stream. At Warwick the scheme is a deplorable failure. A large portion of the land there is water-logged. They were digging out the drains when I was there. Pipe-tiles, 6 or 8 inches in diameter, were filled with sewage matter; and, in fact, the ditches adjoining the estate were half filled with decaying sewage matter. The great bulk of the farm had been sown with Italian rye grass. The grass died out over a large portion of the land. It had not been reploughed and resown, and a great proportion of couch grass was growing magnificently. I understood there was no demand for it, and that large quantities were carted away to be converted into manure. The lower portions of the farm were in an offensive condition, and even when the water was being applied on the upper portion there were large masses of excreta. I do not see why the promoters should possess themselves of this building land when they might obtain lands which can never be other than agricultural, in my opinion. There is some considerable extent of land reclaimed from the sea on the shore of the Ribble. The town of Preston proposed to utilize the northern side for sewage purposes, and by piping this afterwards, which can be done at about £26,000 to £30,000, it might be utilized on all this fresh land with positive advantage and an enormous saving. It would travel by gravitation.

By the COMMITTEE: The sewage has been carried eight miles.

By Mr. LITTLER: I think the system of precipitation succeeded by filtration can be satisfactorily accomplished. It causes some slight smell, which is confined to the interior works, and which arises principally from drying. There is no smell from the effluent water. If the promoters adopt the scheme, it will satisfy, in my opinion, all the requirements of Blackburn. It will avoid being a nuisance to Sir Henry de Hoghton, and would cost much less. I see no extra difficulty in getting rid of the solid matter by this scheme. Three-fourths of the houses of Blackburn are accommodated with ashpits and privies. My opinion is that if the ashpits were kept covered up, and the rain water kept out of them, they would have the excreta retained there and deodorized by the siftings of the ashes from the house of each occupier. Nothing need escape into the drains. Human urine is the best fertilizer we have; and, secondly, human excreta; and those being deodorized, remain there to fructify the land. It seems extraordinary that all this valuable compound which exists amongst ourselves is washed into streams, and thrown way. At a school near Bury, which has a daily attendance of 400 or 500 children, the privies were built on this principle, and they are perfectly innocuous. Rain water is kept out, and fermentation prevented. I know of no case where irrigation is a commercial success. It is a mistake to spend £189,000 in a scheme which is to be recouped (if it is to be recouped) by the profits of irrigation. The best plan would be to try the experiment on a small scale; and if they try it upon a small piece of land it will satisfy all their requirements, and save Blackburn a large sum. The science is not sufficiently advanced to justify the taking against a man's will a large slice off his estate.

Cross-examined by Mr. VENABLES: I think the marshes well adapted to receive the sewage. They are largely composed of sand, with an admixture of sea mud deposit. Nothing objectionable can arise from the sewage whilst in the pipes themselves, and the difference of time of its passing through the pipes, between 14 miles and 4, would not be very considerable. It would flow from 3 to 4 miles an hour. I have not seen the marshes under water since the reclamation took place. I do not think the filtration works would cause any nuisance to Sir Henry de Hoghton at Alton Towers. Building in the neighbourhood has been stopped through nuisance caused by open tanks, not from sewage irrigation works. The most valuable part of Mr. Petre's estate for residential property is that adjoining the turnpike road.

Re-examined by Mr. LITTLER: The last people in the world I would trust with the management of a sewage farm are a corporation.

By the COMMITTEE: If the sewage was got down to the Ribble there would be no difficulty in getting rid of it again. It would be brought into the marsh lands again.

By Mr. LITTLER: There is no population there.

Miscellaneous News.

IMPERIAL GASLIGHT AND COKE COMPANY.

The Ordinary Half-Yearly General Meeting of the Shareholders of this Company was held at the Offices, John Street, Bedford Row, on Thursday, Aug. 25—E. VAUGHAN RICHARDS, Esq., Q.C., the governor, presiding.

The SECRETARY (Mr. Harry Chubb) having read the notice convening the meeting, the corporate seal was affixed to the register of shareholders, and the following report and statements of account presented:—

The accounts of the company for the six months ending the 30th of June last, herewith submitted to the shareholders, show that there is a net balance of £75,363 18s. 3d. available for dividend.

As your directors have anticipated from past experience, the reduction in the price of gas, from 4s. to 3s. 9d. per 1000 cubic feet, which took place at the beginning of the present year, has not had the effect of increasing the demand beyond the ordinary rate. If the consumption had remained stationary, the loss of rental entailed on the company by this reduction would have amounted to about £17,900; in fact, the rental shows a falling off of £12,565, and the difference between these two sums marks the increase which has taken place in the supply of gas to the consumers.

During the past half year the prices obtained for coke and tar have been somewhat better than usual, and the increased receipts arising from the sale of these products almost counterbalance the deficiency in the gas-rental; on the other hand, the expenditure for wear and tear has been, as was anticipated in February last, considerably in excess of that for the corresponding period of 1869.

The result of the half year's transactions is, that the sum of £8607 0s. 5d. will be required to make up the amount necessary for the payment of the half year's dividend. This deficiency will be made good out of the reserve-fund, which now stands at its maximum.

Your directors are proceeding cautiously with the necessary arrangements preliminary to erecting your new works at West Ham; and plans are in preparation for laying out the land which they have acquired for the purpose in the best and most economical manner. If, however, the demand for gas does not increase more rapidly than it has done during the past six months, your directors will be able to take more time in the erection of the works than they at first contemplated.

The new share capital of £325,000, created by the company in February last, has all been subscribed for; a very small number of the new shares, unaccepted by the shareholders to whom they were offered, have been sold in the market for the benefit of the company.

In compliance with the company's Act, 1869, two out of three testing-houses required for the daily examination of your gas have been fitted up and duly certified by the official referees. The third has been delayed in its completion by circumstances over which your directors have no control. It is satisfactory to state that the examiners appointed by the Metropolitan Board of Works have thus far invariably reported the illuminating power of your gas to be considerably above the standard fixed by Parliament.

It is with much regret the directors have to announce the death of Mr. John Southerden Burn, one of the company's auditors, who has filled that office to their great satisfaction for the last 40 years. It will be for the meeting to consider whom they will elect as his successor.

IMPERIAL GASLIGHT AND COKE COMPANY.

Statements of Account for the Half Year ending June 30, 1870.

No. 1.—STATEMENT OF SHARE CAPITAL, *on June* 30, 1870.

Acts of Parliament authorizing the Raising of Capital.	Description of Capital.	Maximum Dividend authorized.	Number of Shares issued.	Nominal Amount of Share.	Called up per Share.	Total paid up.	Amount issued but not paid.	Remaining to be issued and called up.	Total Amount authorized.
17 Vict., cap. 55.	Ordinary.	10 per cent.	26,000	£50 0 0	£50 0 0	£1,300,000	..	..	£1,300,000
Ditto.	Ditto.	Ditto.	26,000	10 0 0	7 0 0	182,000	..	£78,000*	260,000
29 & 30 Vict., cap. 352.	Ditto.	7 Ditto.	26,000	12 10 0	12 10 0	325,000	..	..	325,000
32 & 33 Vict., cap. 128.		7 Ditto.	26,000	12 10 0	2 10 0	65,000	..	910,000	975,000
						£1,872,000	..	£988,000	£2,860,000

* To be called up for paying off debentures as they fall due.

No. 2.—STATEMENT OF LOAN CAPITAL, *on June* 30, 1870.

Acts of Parliament authorizing the Loan Capital.	Description of Loan.	Rate per Cent. of Interest.	Total Amount borrowed, June 30, 1870.	Remaining to be borrowed.	Total Amount authorized.
17 Vict., cap. 55.	Bonds for profits capitalized	10 per cent.	£130,000	..	£130,000
	Debentures	4 to 5 ditto.	35,300	£7,700	43,000
29 & 30 Vict., cap. 352.	Ditto	Ditto.	54,800	26,450	81,250
32 & 33 Vict., cap. 128.	....	..	..	243,750	243,750
			220,100	£277,900	£498,000
Debentures to be paid off, when due, by calls upon the £10 shares			78,000		
			£298,100		

No. 3.—CAPITAL ACCOUNT.

					Certified Receipts to Dec. 31, 1869.	Received since that date.	Total Receipts to June 30, 1870.
To Expenditure, to Dec. 31, 1869			£1,918,724 4 10	By Ordinary £50 shares	£1,300,000 0 0	..	£1,300,000 0 0
Since that date—				Ditto £10 ditto	103,934 0 0	£78,066 0 0	182,000 0 0
Land	£35,905 4 6			Ditto £12 10s. ditto (1866)	301,687 0 0	23,313 0 0	325,000 0 0
New buildings and machinery in extension of works	4,968 7 6			Ditto £12 10s. ditto (1870)	..	65,000 0 0	65,000 0 0
New and additional mains and services	9,037 11 9				£1,705,621 0 0	£166,379 0 0	£1,872,000 0 0
New and additional meters	846 6 0			Bonds for capitalized profit	130,000 0 0	..	130,000 0 0
		50,757 9 9		Debentures	248,100 0 0	..	—
Total expenditure		£1,969,481 14 7		Less debentures paid off	..	80,000 0 0	168,100 0 0
Balance		200,618 5 5			£2,083,721 0 0	86,379 0 0	£2,170,100 0 0
		£2,170,100 0 0					

No. 4.—REVENUE ACCOUNT.

To Manufacture of gas—				By Sale of gas—		
Coals, including dues, carriage, unloading, &c.	£138,211 11 2			Per meter (1,260,763,000 cubic feet)	£234,947 19 6	
Purifying materials, oil, and sundries	3,354 10 7			Public lighting and under contracts	34,543 7 9	
Salaries of engineers and officers at works	1,865 0 0					£269,491 7 3
Wages (manufactory)	21,490 15 9			Meter-rental		6,354 1 9
Repairs and maintenance of works and plant, machinery, apparatus and tools, materials and labour—less £557 2s. 6d. received for old materials	36,859 18 7			Residual products—		
		£201,781 16 1		Coke, less charges, and £212 15s. 3d. loss on breeze	£48,604 19 7	
Distribution—				Tar	5,828 6 1	
Salaries and wages of officers connected with distribution	£4,294 15 11			Ammoniacal liquor	2,400 13 8	
Repairs, maintenance, and renewals of mains and services, including materials, paving, and labour	4,219 9 6					56,833 19 4
Meters—repairs and renewals	4,281 0 8			Rents receivable		677 12 9
		12,795 6 1				
Public lamps—						
Lighting and repairing		6,782 16 10				
Rents, rates, and taxes—						
Rents payable	£1,483 16 8					
Rates and taxes	5,493 19 5					
		6,977 18 1				
Management—						
Directors allowance	£2,000 0 0					
Company's auditors	78 15 0					
Salaries of secretary, accountant, and clerks	4,208 3 0					
Collectors commission	4,254 17 4					
Stationery and printing	1,481 13 11					
General charges and incidentals	826 2 5					
		12,849 11 8				
Law charges		362 19 8				
Bad debts		2,528 11 11				
Gas referees and official auditor	£727 3 7					
Public testing-offices	723 11 4					
		1,450 14 11				
Total expenditure		£245,529 15 3				
Balance, carried to profit and loss account (No. 5)		87,827 5 10				
		£333,357 1 1				£333,357 1 1

No. 5.—PROFIT AND LOSS ACCOUNT (NET REVENUE).

To Amount carried to Reserved Fund Account (No. 6)	£23,859 18 7	By Balance from last account	£101,677 3 8	
Ditto to Contingency ditto (No. 7)	2,640 6 0	Less dividend for the half year ending Dec. 31, 1869	75,176 19 1	
	£26,500 4 7		£26,500 4 7	
Interest on bonds and debentures, to June 30, 1870	10,634 19 3	Amount from Revenue Account (No. 4)	87,827 5 10	
Ditto on calls anticipated, and on temporary loans	1,700 12 7	Interest on moneys deposited	174 13 1	
Contingency-fund	1,500 0 0	Premiums on sale of shares	1,197 12 0	
Balance, being the net profit for the half year ending June 30, 1870	75,363 18 8			
	£115,699 15 6		£115,699 15 6	

No. 6.—RESERVED FUND.

To Balance	£81,250 0 0	By Balance from last account	£56,731 9 10
		Dividends on Consols	658 11 7
		Amount from Profit and Loss Account (No. 5)	23,859 18 7
	£81,250 0 0		£81,250 0 0

No. 7.—CONTINGENCY-FUND.

To Balance	£47,777 5 4	By Balance from last account	£43,003 5 9
		Dividends on Consols	633 13 7
		Amount from Profit and Loss Account (No. 5)	4,140 6 0
	£47,777 5 4		£47,777 5 4

No. 8.—STATEMENT OF COALS.

Description of Coal.	In Store, Dec. 31, 1869.	Received during Half Year.	Carbonized or used during Half Year.	In Store, June 30, 1870.
	Tons.	Tons.	Tons.	Tons.
Newcastle	24,831	155,046	160,473	19,404
Cannel	3,878	11,874	12,479	3,273
	28,709	166,920	172,952	22,677

No. 9.—STATEMENT OF RESIDUAL PRODUCTS.

Description of Residual.	In Store, Dec. 31, 1869. Estimated.	Made during Half Year. Estimated.	Used in Manufacture during Half Year. Estimated.	Sold during Half Year.	In Store, June 30, 1870. Estimated.
Coke—chaldrons of 36 bushels	3,972	180,532	52,506	130,229	1,769
Breeze—ditto ditto	954	20,951	100	21,398	407
Tar—gallons	229,526	1,612,759	82,728	1,596,864	162,693
Ammoniacal liquor—butts of 108 gallons	1,301	22,415	..	22,191	1,615

No. 10.—BALANCE-SHEET.

To Capital, for balance per account (No. 3)	£200,618	5	5	By Amount invested in Three per Cent. Consols—		
Reserved fund, for amount of account (No. 6)	81,250	0	0	Reserved fund	£81,250	0 0
Contingency-fund, ditto (No. 7)	47,777	5	4	Contingency-fund	46,277	5 4
Interest due to June 30, 1870, on bonds, debentures, and on calls anticipated	12,312	4	6	Cash at bankers and on deposit	157,381	12 9
Sundry tradesmen and others, for amount due for coals, stores, &c., to June 30, 1870	34,652	19	1	Gas and meter rental, for amount due to company, to June 30, 1870	120,137	15 8
Profit and loss, for balance of account (No. 5)	75,363	18	8	Coke and other residuals, ditto	3,897	5 5
				Sundry accounts	1,373	14 3
				Coals, for stock on hand	19,046	13 0
				Coke and breeze, ditto	600	7 8
				Tar and ammoniacal liquor, ditto	713	0 9
				Sundry stores ditto	21,296	18 2
	£451,974	13	0		£451,974	13 0

I have examined the above accounts, and certify them to be correct. THOMAS YATES, *Auditor.*

I hereby certify that the above accounts are correct, and that there are no losses or forfeitures to be deducted from the dividends.
CHAS. H. PARKES, *Official Auditor.*

The GOVERNOR: Gentlemen, when last you had the misfortune to listen to my observations, so many topics crowded themselves upon our attention that I think my address to you was protracted for something like an hour. I have the satisfaction to inform you that on the present occasion I have very little to say. During the last session we fortunately steered entirely clear of the lobby of the House of Commons, and therefore we have no parliamentary conflicts to record, no victories to exult in, no defeats to deplore. Nothing could have been more uneventful than our proceedings during the last six months. The report now presented, brief as it is, gives you, I think, a pretty clear epitome of our progress during that period. We, of course, knew that the reduction in the price of gas must entail a certain loss of rental. We calculated with tolerable accuracy that it would be something like £17,000, and against that, of course, had to be set off any increase which would arise from the augmented demand for gas. For some reason or other—I can suggest no explanation—the increase in the demand for gas in the past six months unquestionably has not been as large as from experience we were led to expect. The result, as shown in the report, is that our loss upon rental amounts to £12,000. The accidental circumstance of having had a better sale for residuals than usual just gives us £12,000 to meet the loss upon our rental. On the other hand, there is an unusually large "Wear and tear account." We are not taken by surprise by this. Those who were present at our meeting in February will remember that I expressly informed the shareholders that the "Wear and tear account" for this and the next half year would be in excess of the usual amount, and I then gave in detail the reason for it. The result on this occasion is that we have to take from the reserve-fund a little over £8000, to enable us to pay the maximum dividend allowed by law. I do not see any ground for being disappointed at our present position, or for prognosticating evil in the future. So much for our financial position. We have bought some land at West Ham, with a view to the erection of additional works there, and we are about to buy—in fact, we have in hand a negotiation for the purpose—some further land, of which it appears desirable we should become the possessors. We have also entered into an arrangement with an eminent engineer—Mr. Barlow—for the erection of a bridge across the Lea. We have two gentlemen on the staff of the company—Mr. Kirkham and Mr. Clarke—either of whom would be perfectly competent to erect a bridge over that river of such a rigid and strong character as would suffice to carry our mains; but the Lea is a navigable river, and it is necessary to keep the navigation open all the time, and we could not help feeling that, in case of any accident, the question might arise why we should employ a gentleman whose speciality was that of a gas engineer, rather than a person of reputation as a bridge engineer. Under these circumstances we thought it desirable to go to Mr. Barlow, a gentleman who stands very high in his profession, and the employment of whom would not, as our lively neighbours across the Channel would say, wound "the just susceptibilities" of our own engineers. That work is now in hand, and I trust next time we meet you I shall be able to give a good account of its partial erection. I am sorry to say that this is probably the last, or nearly the last, time that we shall meet in this room. The necessary increase of our staff, arising out of the extension of our works, is such that the office has become overcrowded, and the only relief we can obtain is by devoting this room to the transfer department. We have no other room on the premises sufficiently large for the meetings of our shareholders, and our only alternative will be to hold those meetings in the future at some neighbouring tavern, or some other public building capable of accommodating us. I confess that, having attended something like forty general meetings in this place, I feel almost a sentimental regret at leaving it; but the exigencies of the office require it, and the change cannot long be postponed. There is only one other subject I will refer to, and that is the election of an auditor. I know not who may be proposed for that office. The directors have studiously abstained from the slightest interference in the matter. They regard the auditor as a person selected by yourselves to act in some respects as a check upon the directors. He holds the balance between us, and as representing you he has to see that we have done our duty. We even abstained from telling you the names of any gentlemen who might be proposed, for fear you should think we had any bias in the matter. We leave it in your hands to select some gentleman of substance who has a reasonable and proper stake in the concern, who will unflinchingly, and in no captious spirit, address himself to the investigation of the accounts. I now move—"That the report and accounts now read be approved and entered on the minutes."

The DEPUTY-GOVERNOR (Mr. B. F. Watson) seconded the motion, which was put, and carried unanimously.

On the motion of the GOVERNOR, a formal resolution, declaring the maximum dividends on the various classes of shares, was passed, payable on the 1st of September next.

The GOVERNOR: We now come to the election of an auditor, consequent on the death of our friend, Mr. Burn, who for forty years had served you in that capacity. At the time the notice convening this meeting was issued the directors considered the appointment of a successor was optional, but on carefully looking through the Companies Clauses Act we find that you are bound to make the appointment. For the reasons I have given we abstained from interfering in the matter, and now invite a proposition from any gentleman present.

Mr. CLIFTON proposed, and Mr. HENRY seconded, the appointment of Mr. William Hawes as auditor.

There was no other nomination, and Mr. Hawes was unanimously elected to the office.

On the motion of Mr. MOORE, seconded by Mr. LATTER, a cordial vote of thanks was given to the directors.

The GOVERNOR acknowledged the vote, and the proceedings terminated.

RATCLIFF GASLIGHT AND COKE COMPANY.

The Half-Yearly General Meeting of the Shareholders of this Company was held at their Offices, Cable Street, on Tuesday, Aug. 16—ANDREW WILSON, Esq., in the chair.

The SECRETARY (Mr. H. J. Baddeley) having read the notice convening the meeting, the following report and trade account for the six months ending the 30th of June were presented:—

The directors have much pleasure in submitting their report and accounts for the half year ended June 30, 1870.

The requirements of the Board of Trade have necessitated an alteration in the form of rendering the company's accounts, which have been examined and certified by the auditors.

Out of the net profit—namely, £5815 9s. 4d.—the directors recommend that a dividend upon the paid-up capital of the company, after the rate of 5 per cent. for the half year ended June 30, 1870 (less income-tax), be now declared payable on and after the 10th day of October next.

Dr. *Trade Account, for the Six Months ended June 30, 1870.* *Cr.*

To Coals		£6,648	9 4	By Gas	£14,165	0 7
Purifying materials		161	4 4	Public lighting	1,964	4 9
Salaries of engineer and clerk at works		275	0 0	Rental of meters	4	0 0
Wages		1,726	4 6	Coke	2,930	14 5
Repairs & maint. of works & plant, & labour £1378 18 3				Breeze	36	14 1
Less old matrl. sold	35 10 0			Tar	417	9 8
		1,343	8 3	Ammoniacal liquor	366	17 5
Salaries of inspectors and clerks in office		305	8 0	Miscellaneous receipts	142	18 7
Repairs and maintenance, distribution, and labour		824	2 3			
Repairing and renewing meters		275	5 4			
Lighting and repairing public lamps		339	5 3			
Rents		130	8 2			
Rates and taxes		409	4 2			
Directors allowances		400	0 0			
Salaries of secretary, accountant, &c.		325	15 0			
Collectors commission		203	4 0			
Stationery and printing		43	16 5			
General establishment charges		106	3 1			
Auditors		15	15 0			
Parliamentary charges		4	0 10			
Depreciation-fund (leaseholds)		110	0 0			
Bad debts		174	1 3			
Interests on borrowed capital		391	15 0			
Net profit		5,815	9 4			
	£20,027		19 6		£20,027	19 6

The CHAIRMAN, in moving the adoption of the report and accounts, said he had but very few words to address to the shareholders. The accounts were so simple and straightforward that they called for no explanation, while the state of the company's works and the general affairs of the company were so satisfactory that he need occupy no time in referring to them at length. During the last six months the directors had taken up a number of small mains and laid down larger, so as to facilitate the supply of gas in the district. The reduction in the price of gas had not prevented the payment on the present occasion of the maximum dividend of 10 per cent., and the directors anticipated that, with the able assistance of their engineer, the working of the company during the next half year would show even better results than the present accounts disclosed.

Mr. BROMLEY seconded the resolution, which was put, and carried unanimously.

The CHAIRMAN moved—"That a dividend for the half year ending June 30, 1870, upon the paid-up capital of the company, after the rate of 5 per cent., less income-tax, be now declared payable on and after the 10th of October next."

Mr. BADDELEY seconded the resolution, which was put and carried.

On the motion of Mr. PITT, the thanks of the shareholders were voted to the chairman and directors for their services during the half year.

The CHAIRMAN having acknowledged the vote,

Mr. PITT moved a vote of thanks to the secretary, which was cordially adopted, and having been acknowledged, the proceedings terminated.

WESTERN GASLIGHT COMPANY.

The Ordinary General Meeting of this Company was held at the Offices, Argyll Street, Regent Street, on Thursday, Aug. 18—F. W. RUSSELL, Esq., M.P., in the chair.

The following report of the directors and statements of account were submitted:—

The directors, in submitting to the shareholders the usual statement of accounts for the year ended the 30th of June last, have the pleasure to report that, as compared with the previous year, the gas and meter rental has increased £10,820, the return for coke and other products £3529, and the total income of the company £14,364. The net profit resulting from the twelve months operations amounts to £50,342 4s. 8d.; the sum required for the two half-yearly dividends, at the authorized rate of 10 per cent., being £37,000.

The surplus of £13,342 4s. 8d., which will remain after payment of the dividend for the second half of the year, will increase the amount of the reserve-fund to £21,028 7s. 3d., equal to upwards of 5¾ per cent. on the present paid-up share capital.

Although the company is entitled to accumulate a much larger reserve before it can be called upon under the Metropolis Gas Act to reduce the price of gas, the directors, having regard to the general position of the concern, and to the prospective extension of consumption, have determined upon making a voluntary reduction at Christmas next, from 5s. 6d. to 5s. per 1000 cubic feet; and believe that the propriety of this substantial concession to the consumers will be readily acquiesced in by the shareholders. The reduced price will be equal to 3d. per candle of minimum illuminating power, the standard fixed by the Act for cannel gas being 20 sperm candles.

The directors recommend that the following dividend, at the usual rate per cent., be declared and forthwith paid for the second half of the financial year, viz:—

10s. per	A Share	£10	paid
8s. „	New B „	8	„
8s. „	C „	8	„
1s. „	D „	1	„

Messrs. Francis Edwards, and Vandeleur Benjamin Crake, and Lieut.-Col. William Thomas Makins, directors, and Mr. Thomas James Briggs, auditor, retire by rotation, and respectively offer themselves for re-election.

Dr. *Revenue Account, for the Year ended June 30, 1870.* *Cr.*

To Coal			£65,257	1	8	
Supervision and labour			13,614	2	3	
Purifying materials, water, oil, and sundries			3,457	7	9	
Works renewal			3,508	1	4	
Restoring pipes and meters			2,952	8	2	
Lamp lighting			1,989	17	4	
Repairing lamps			631	12	9	
Direction and audit			1,370	0	0	
Salaries			3,901	7	8	
Collectors commission			1,425	5	5	
Rents, rates, and taxes			2,272	0	7	
Stationery and printing			351	10	11	
Incidental expenses			1,148	15	1	
Bad debts			898	12	9	
Leasehold redemption-fund			240	2	0	
Profit of year to June 30, 1870, carried to profit and loss account			51,873	3	9	
			£154,891	9	5	

By Gas			£136,944	6	11	
Meter			3,278	3	0	
						£140,222 9 11
Coke		£6,680	13	10		
Breeze		1,927	12	5		
Tar		5,281	2	7		
Gas liquor		764	0	8		
					14,653	9 6
Transfer fees					15	10 0
					£154,891	9 5

Dr. *Profit and Loss.* *Cr.*

To Reserved fund			£7,450	0	6	
Interest on loans			1,530	19	1	
First half year's dividend, declared February last	£18,000	0	0			
Balance to be appropriated	32,342	4	8			
			50,342	4	8	
			£59,323	4	3	

By Balance from June 30, 1869			£25,450	0	6	
Less dividend declared August, 1869			18,000	0	0	
					£7,450	0 6
Revenue account (profit of year, to June 30, 1870)					51,873	3 9
					£59,323	4 3

Dr. *General Balance-Sheet.* *Cr.*

To Proprietors capital, viz.:—						
20,000 A shares (£10 each)	£200,000	0	0			
10,000 new B's (£8 paid)	80,000	0	0			
10,000 C's (£8 paid)	80,000	0	0			
20,000 D's (£1 paid)	20,000	0	0			
				£380,000	0	0
New B share loan account	£2,784	0	0			
Bonds and debentures	27,000	0	0			
			29,784	0	0	
Sundry creditors			9,894	1	4	
Unclaimed dividends			161	8	0	
Reserved fund			7,686	2	7	
Leasehold redemption-fund			490	4	10	
Profit (balance to be appropriated)			32,342	4	8	
			£460,358	1	5	

By Permanent investment			£383,061	1	0	
Sundry debtors			31,577	1	2	
Stock in trade			11,208	3	7	
Reserved fund, viz.—						
£8083 9s. 7d. Consols and half year's interest to date			7,686	2	7	
Cash in hand and on deposit			26,125	13	1	
			£460,358	1	5	

On the motion of the CHAIRMAN, seconded by Mr. L. SIMPSON, the report and accounts were unanimously adopted.

The CHAIRMAN moved, and Mr. SIMPSON seconded, the payment of the dividend recommended in the report, which was also unanimously agreed to.

The retiring directors and auditor were re-elected, and thanks were voted to the board for their services.

ALUM AND AMMONIA COMPANY, LIMITED.

The Eleventh Ordinary General Meeting of the Shareholders of this Company was held at the Works, Bow Common, on Friday, Aug. 26—Colonel A. A. CROLL in the chair.

The SECRETARY (Mr. Guyatt) having read the notice convening the meeting, the following report was presented:—

The directors have the pleasure to lay before the shareholders the balance-sheet, duly audited, showing the position of the company at the 30th of June last.

It will be seen thereby that the operations of the company continue very satisfactory, and the directors are pleased to report that the demand for the various articles manufactured continues unabated, while the price of alum, one of the principal manufactures of the company, has advanced since these account were made up.

During the twelve months, £4140 16s. 2d. has been expended in the purchase of a freehold property adjoining the company's works at Bow, and for the construction of additional plant in London and Glasgow. The directors have, however, charged against current revenue the whole of the cost of the additional plant, placing to capital only the cost of the freehold property referred to, amounting to £721 0s. 4d.

The balance to be now dealt with, after charging revenue with the sum before mentioned, and the amount of the interim dividend paid in February, is £11,541 5s. 3d.

The directors therefore propose to pay the usual dividend at the rate of 10 per cent. per annum, free of income-tax, making with the interim dividend paid in February 10 per cent. for the year, and to carry the balance to the credit of undivided profits; the amount of that account will then be £7368 0s. 3d.

At the request of the directors, Mr. Nicholson visited the works at Glasgow, and he thus reports upon his visit:—

"*To the Chairman and Directors of the Alum and Ammonia Company, Limited.*

"Dear Sirs,—As representative of the Finance Committee, I have superintended, at the several works of the company, the annual stock-taking. The word 'annual' suggests to me this observation—namely, that the shareholders exercised a wise discretion in determining that the stocks should be taken only once a year, at the end of June. In any case the time and labour occupied, and the interruption to some of the processes of manufacture, involved in these operations, are more or less disadvantageous, but the summer half year affords the greatest facilities for the purpose. I can confidently certify the accuracy of the stock lists herewith placed before you. I have also great pleasure in stating that the works and plant are in excellent condition; and I need hardly remind you of the fact that all the cost of reparations, restorations, and extensions in buildings, as well as apparatus, has been charged against current revenue."

The CHAIRMAN, in moving the adoption of the report, said: I might have been content with simply congratulating you upon the prosperous condition of the company, as indicated by the report and accounts. I wish, however, to make one or two observations. Since the commencement of the company we have paid a regular dividend of 10 per cent. per annum, and, while doing this, have written off the whole of the preliminary expenses, charged against current revenue the whole cost of renewals, and during the past year have expended between £3000 and £4000 upon additional plant, which is also charged against current profits; the whole apparatus of the company is in a better state than at any former period, while the undivided profit is nearly equal to twelve months dividend at 10 per cent. This statement is fully authenticated not only by the Finance Committee of the board, but by the auditor appointed by the shareholders, and by Messrs. Quilter, Ball, and Co. I have no doubt, however, that a very natural question will occur to your minds—viz., what effect is the war likely to have upon the interests of the company? I answer that nearly the whole of the produce that we can manufacture, so far as ammonia and acid are concerned, has been sold to responsible parties. A large proportion of the salts of ammonia has been sold for shipment to German ports, and the war has interfered with its delivery; but this is only temporary, and but for this we should have had the cash at our bankers, instead of the large quantity of this article in our warehouses at Glasgow and here. As regards the acid, the contracts are made with consumers in London, and will absorb all we can spare up to June, 1871. In reference to the most important of the productions of the company—viz., alum—this is an article which is rarely contracted for beforehand, but is purchased as required. You will observe that we have less in stock than at any former period, while our plant for the production of the article is employed to the fullest extent. It so happens that out of the United Kingdom the largest manufacturers of alum are situated in France and Germany, and in consequence of the sad war between the two nations we have already been enabled to increase the price of potash alum, and should the war continue the price will be still further advanced. But, gentlemen, I am sure you will excuse me in saying, and I have no doubt you will, one and all, join me in the expression of the hope that this most iniquitous war may be brought to a speedy termination, whatever effect its continuance might have upon the interests of the company. With these remarks I beg to move—"That the report and accounts be received and adopted, and that the usual dividend, at the rate of 10 per cent. per annum, free of income-tax, be now declared and paid."

Lord A. S. CHURCHILL seconded the motion.

Mr. BRADING said he considered that the accounts laid before the meeting were most satisfactory, but he thought it would be well that the directors should take into consideration the propriety of appropriating a portion of the balance of undivided profits to the formation of a reserve-fund.

Mr. DOWLING objected to the appropriation of any portion of the balance in the way suggested. While it remained in the accounts as "undivided profits," there was a hope that, in some future year, the directors might feel themselves justified in recommending the distribution of a part of it in the form of bonus; but, if it were permanently appropriated, such a hope would be entirely gone.

After some conversation respecting the propriety of publishing the accounts of the company,

The motion for the adoption of the report and declaration of dividend was put, and carried unanimously.

The retiring directors and the shareholders auditor were re-elected.

The CHAIRMAN referred to the valuable service rendered the company by Mr. Guyatt. He said the directors regarded him as a man of great energy and ability, thoroughly trustworthy, and possessing a large amount of prudence and good practical common sense. He believed the shareholders would agree with him in his estimate of the worth of their secretary, and unite in a cordial vote of thanks to him for the manner in which he had discharged his duty.

The motion was seconded by Mr. C. FLOWER, and spoken to by Mr. DOWLING, and carried by acclamation.

Mr. GUYATT acknowledged the vote, and said he was greatly obliged by the kind manner in which his name had been mentioned in connexion with the business of the company. He could assure the meeting that his heart was in the work, and, with the able assistance of the excellent staff of the company, he trusted they would continue to meet in the future, as in the past, to congratulate each other upon the prosperous condition of the company.

A vote of thanks to the chairman and directors closed the proceedings.

BRADFORD TOWN COUNCIL.

A Quarterly Meeting of the Town Council was held at the Court House on Tuesday, Aug. 16, at which the MAYOR presided. The attendance of councillors was small.

PROPOSED PURCHASE OF THE GAS-WORKS.

The following report, which had been printed and circulated amongst the members of the council, was presented, and taken as read:—

The committee appointed by the council, on the 21st of December last, to inquire as to the desirability of the supply of gas for the borough being placed in the hands of the corporation, report as follows:—

Your committee have collected information from a large number of boroughs, where the supply of gas is undertaken by the corporation, as to the experience of such corporations in the matter. It appears that, in one or two instances, the works were originally established by the public authorities, as at Manchester, in which city, as your committee are informed, the profits have enabled the corporation to effect all their public improvements without levying any rate for the purpose. In other places the works were established by private companies, and were subsequently acquired by the corporation under authority of Parliament. It is to cases of the latter class that your committee have principally directed their attention, and they find the uniform result to be that, either by improvement in the quality of gas without additional charge, or by preserving the quality and reducing the charge, or by both raising the quality and lessening the cost, the public have been gainers by the change; and, in addition, have had a considerable profit to apply for the benefit of the town. This will be best illustrated by the nine following instances of towns where the local authorities have purchased gas-works previously in the hands of a company:—

Birkenhead has reduced the price of gas 1s. per 1000 feet since the works were transferred from a company to the local authorities. The quality of the gas has not been changed, but a considerable profit has been realized and applied in aid of public works.

Burnley has improved the quality of the gas since the transfer to the corporation from 12 to 17 candles. Although the old company dropped their price from 4s. 6d., when the corporation proposed to take the works, to 3s. 6d. per 1000 feet, no increase of price has been since made; and an annual profit has been realized for the benefit of the town during the last fourteen years.

Greenock has reduced the price, increased the illuminating power about one-third since the transfer, and realized considerable annual profit in addition.

Halifax has increased the quality of the gas since the transfer from 12 to 17 candles, and has also annually realized considerable profit.

Oldham has improved the quality of the gas since the transfer from 12 to 16¼ candles, reduced the price 1s. 2d. per 1000 feet, and realized a considerable annual profit.

Paisley has maintained the high quality of its gas since the transfer—28 candles—reduced the price 2s. 9d. per 1000 feet, and realized an annual profit.

Stockport has improved the gas from 10 to 24 candles without increasing the charge, and realized a considerable annual profit.

Stockton has improved the gas to the extent of 4 candles, reduced the charge 9d. per 1000 feet, and realized an annual profit.

Rochdale has improved the gas from 15 to 20 candles since the transfer, reduced the price 2s. 8d. per 1000 feet, and made a profit of nearly £51,000, which has been expended in town improvements.

It will be in the recollection of the council that at the time your committee were appointed great complaints had been made in the town of the insufficiency of the supply of gas, and of its inferior illuminating power. From information collected as to other towns, your committee found that, taking into account the specific illuminating power of the Bradford gas, and the charge for the same, the price paid in Bradford is higher than it should be, and that the quantity and illuminating power are not sufficient.

On these and various other grounds, your committee could only arrive at the conclusion that it would be for the benefit of the borough to have the supply of gas in the hands of the corporation. They thereupon proceeded to examine the provisions of the company's Acts, and also to examine the statements of the company's accounts annually filed with the clerk of the peace. The result was that it appeared to your committee that the company had not been correctly carrying out their powers. One of the provisions in the company's Acts is that if it shall appear from the annual filed accounts that the profits of the preceding year shall have exceeded the sum authorized to be divided amongst the several proprietors of shares in the undertaking, the company shall make a rateable reduction in the rents and price of gas supplied for the then current year, as the company may deem prudent, or as in the judgment of the Court of Quarter Sessions shall be proper. Instead of thus acting, the company have for many years past allowed a large sum of profits to remain in hand to the credit of the profit and loss account. They had, during the 18 years ending the 30th of June, 1869, transferred from that account other large sums to reserve account, and they have transferred from that account to capital account an aggregate sum of £130,275, which has been applied to the making of new works, &c., but have not, as they should have done according to their Acts, applied the excess of profits beyond dividend in reducing the price of gas to the consumer.

One reason for this procedure may be collected from a provision contained in the company's Acts, which requires that if the company want to raise capital for new works or otherwise, they must offer the shares for sale by public auction or otherwise, and directs that "any sum of money which shall arise upon such sale by way of premium, shall be expended in extending or improving the works of the company, and shall not be considered as part of the capital thereof."

The company did in 1851 and 1853 raise £10,000 by sale of shares, which realized nearly £9000 in premiums. The latter sum, however, bore no dividend, so that the capital invested hythe purchaser produced little more than 5 per cent. The operation has never since been repeated, and the company have subsequently got all the moneys they wanted out of consumers profits, not by sale of shares.

Whatever the ultimate object of the company, the effect of this procedure would be to accumulate in the hands of the shareholders valuable works created out of moneys paid by the consumers, and not by the holders of shares. In 1845, when the company went to Parliament, they had effected a similar state of things, and they were then permitted to allot to each holder of one share of £25 two more shares of £25 each, without payment; all of them bearing a dividend of £19 per cent. per annum. Having once effected such an advantageous operation, the company may have looked forward to a repetition of it at a future day, or they may have calculated upon a purchaser turning up of whom they could demand, not the price of their dividend-bearing shares, but the value for themselves of the works constructed with the consumers money.

Having thus ascertained how the affairs of the company stand, your committee had an interview with a deputation from the company. The latter did not dispute the propriety of the corporation taking the supply of gas for the borough into their own hands; on the contrary, they expressed themselves ready to transfer the whole concern to the corporation, but based their valuation as to price upon the gross income the concern is likely to yield next year, estimated at 10 per cent. more than the present income. Your committee explained to the deputation the various objections which existed against this mode of calculation, pointed out the grounds on which the proceedings of the company were open to exception, and contended that in effect the consumers were being asked to buy back again works which their funds had created. On behalf of the company, all the views expressed by your committee were disputed, and of course it was impossible to agree upon price.

It was thereupon considered desirable to obtain advice on behalf of your committee from some eminent practical authority on the subject, and Mr. Hawksley was accordingly applied to. Mr. Hawksley, as is well known, is a staunch supporter of gas companies, and this fact was an additional inducement to obtain his opinion, your committee being in the hope that his views, whatever they might be, would be entitled to acceptance at the hands of the company. Mr. Hawksley went very carefully into the whole question. Having before him a copy of all the annual statements of accounts filed by the company, he says—and your committee think it only just to the company to mention such statement—that he had no difficulty in understanding the deposited accounts, which, he adds, clearly and distinctly, and without any attempt at concealment, set out the transactions of the company; but when he deals with the principle on which the company have acted, he is constrained to admit that the company are in the wrong, "particularly in the misappropriation of its surplus revenues derived from the sale of gas and residual products, partly to the purposes of capital, and partly in the liquidation of loans obtained on capital accounts"—"instead of applying such surplus profits to the creation of the standing reserve-fund, and from time to time in the reduction of the price of gas." In reference to the accounts of the reserve-fund, Mr. Hawksley says they are "mere records of transactions by the company without and beyond the power of their Acts of Parliament, transactions doubtlessly truthfully entered, but which were nevertheless entirely wrong in themselves, and eminently injurious to the interests of the consumers of gas for the time being." In reference to the inquiry as to the usual course adopted in such cases for correcting irregularities, Mr. Hawksley admits that redress might be obtained either on application to the quarter sessions, or by a bill being filed against the company in equity; but he observes that as the object of the corporation "is not to proceed against the company litigiously, it is well to inquire into the actual value of the company's present interest in the undertaking considered irrespective of these irregular transactions." He then deals with that part of the business, and states what in his view is a liberal price to be paid to the company by the corporation on behalf of the public for the purchase of the works.

It was also deemed desirable to ascertain how far your committee would be supported by eminent legal authority. The joint opinion of the Attorney-General, Sir Robert Collier, and Mr. Hannay, Recorder of Pontefract, was accordingly obtained. They consider that the company were bound to apply any excess of reserve-fund in the reduction of the price of gas; and they say, "It appears to us from the accounts which have been shown us"—the annual statements filed by the company at Wakefield—"that the company systematically evaded compliance with the directions of the Legislature on this subject."

Your committee subsequently had further interviews with the deputation from the gas-company. Mr. Hawksley's report was read to them throughout, and they were informed of the legal advice given to the corporation; but no conclusion was arrived at on the question of price.

Your committee do not feel at liberty to proceed further in the business without instructions from the council, and accordingly they report:—

That in their opinion it will be for the benefit of the town that the supply of gas should be placed in the hands of the corporation.

That the council should empower your committee to take such steps as they may deem expedient for effecting that object, including the purchase of the company's works, upon terms to be approved by the council.

And that authority should be given to the committee to apply to Parliament for the necessary powers to carry out all or any of the above objects.

Aug. 6, 1870. S. SCOTT, Chairman.

Alderman SCOTT then moved the adoption of the report, and that, in accordance with the recommendation therein contained, the committee be empowered to take such steps as they might see fit for effecting the transfer of the gas-works to the corporation, subject to the approval of the council. He said it was now about eight months since the council passed a resolution requiring the Smoke Prevention Committee to look into the subject of the supply of gas within the borough being put into the hands of the council. That committee had had many meetings on the subject since then, had prosecuted inquiries in all directions, and they had drawn up their report. He hoped that the report might be found to be so full, complete, and satisfactory as to save him from making any speech on that occasion. He did not think he could serve the purposes of the committee by adding anything to what was already in the report. If it had been his good fortune to come before the council with a recommendation as to the immediate purchase of the works, at a certain price agreed upon by the committee and the directors of the gas company, then it would have been proper for him to make some statement as to the nature and value of the property which they proposed to purchase, and as to how far it could be further developed, and made a source of revenue to the town. But, inasmuch as it was not his good fortune to come before the council with such a recommendation, as the interviews between the committee and the gas directors had not resulted in any such proposition, he thought he should not be serving the purpose the corporation had in view, but rather the purpose of what he might call the opposition, if he went any further into the question than the report did. At the same time he was prepared to answer, as far as he could, any questions with regard to the various matters referred to in the report which might be put. He thought the report established, in the first place, that corporations were able to manage gas-works successfully. He knew there wasa feeling a mongst some members of the corporation that they could not manage such an enterprise as that so well as it was managed by a private company. He did not wonder that such a feeling existed. They were not always successful in their undertakings. Sometimes they had something to learn, and perhaps they were not always best advised. But he saw nothing, and he had seen nothing, in their correspondence with other towns to lead him to believe that there was anything in the management of gas-works which should make a corporation afraid to take them in hand. The report also established the fact that, wherever thus taken in hand, gas-works had been a source of revenue to the corporation, and the transaction had been a matter of satisfaction to the public. It might also be taken for granted—and it could be proved more fully than the figures given in the report proved it—that the Bradford Gas-Works was a successful enterprise, and one that had developed largely since it was founded, and would no doubt develop largely in future. These positions being established, it became the duty of the corporation to see whether they could not obtain a transfer of the works to themselves, upon such terms as would make them a source of revenue to the corporation in future, and, at the same time, fairly remunerate the shareholders of the gas company.

Mr. BROADBENT seconded the motion.

Mr. BARBER thought the question a very important one to be decided upon by so small a number of the council as were present at that meeting, and suggested that it should be deferred till another meeting. He also observed that the comparisons with other towns, made in the report, did not afford much information as to the price paid for gas in Bradford, compared with what was paid in the places referred to.

Mr. BOOTHROYD thought that before the council committed themselves to the principle of purchasing the gas-works, the matter should be discussed, and the views of the council settled upon it. The end and design of the purchase was to make the gas-works a source of revenue, whereby the ratepayers generally might be relieved from burdens, but this was to be done at the expense of the gas consumers. Why should it be done at the expense of the gas consumers more than at that of others? Why not carry out that principle in other things? It was to him rather a difficult question. The shopkeepers, as a class, felt the burden of the consumption of gas more perhaps than any other class. In such a town as Bradford the shopkeepers, who necessarily required expensive sites for their shops, paid a large, and he had almost said more than their fair share, of the local rates. This being the case, he could not quite see why this class should be taxed additionally in the consumption of gas in order to relieve, not their own rates only, but those of the ratepayers generally. He observed that, according to the Act on which the gas company was founded, as they realized profits they were bound, by the privilege which they had of furnishing the town with gas, to reduce the price of gas to consumers. It was a question whether it would not be better, rather than transfer the gas-works to the corporation, that the latter should see that the company reduced the price of gas from time to time, as the per centage on the profit allowed them to do. Mr. Boothroyd said he should like to know also whether it was likely that an amicable arrangement could be made with the gas company, or whether the pressure of public opinion would have to be brought to bear upon the matter, and they would have to apply for an Act of Parliament to enable the corporation to effect the transfer. If the latter was the case, they might have a valuation of the gas-works made, which would render it very difficult for the corporation afterwards to make the works a paying investment.

Alderman BRAYSHAW wished to know whether, at their meetings with the committee, the directors of the gas-works had expressed themselves willing to sell the works at any price. If they had, the question was simply as to whether the corporation and the directors could agree as to terms.

Alderman FARRAR expressed himself exceedingly glad that the question of the transfer of the gas-works had been taken up by the council, and he hoped it might be prosecuted to a successful issue. He thought there should be no delay in the matter. In answer to the remarks of Mr. Boothroyd, regarding the hardships which would be inflicted on shopkeepers by the proposed transfer, he reminded that gentleman that shopkeepers were not the only large consumers of gas, but that much was also consumed in mills and private houses. One advantage of the transfer would be that the corporation would obtain entire control of the streets.

Alderman SCOTT, in reply, said he was obliged for the considerate way in which the council had treated the subject. Mr. Barber had complained that there was no information in the report as to the price of gas in other towns as compared with the price in Bradford. He could give that information, but, complicated as it would be for the purpose of comparison by information as to the quality of the gas, as to the discounts upon it, and as to the charge

for meters or otherwise, he thought it would not throw much light upon the question. Whatever price corporations had had to pay to gas companies on the transference of the works, they had been able afterwards either to reduce the price or to make a profit upon the price for the benefit of the public; and the question of what price was paid did not determine whether Bradford was worse off than other places. Bradford might be more favourably situated for making gas than other places. It might be more profitable to supply Bradford with gas at 3s. per 1000 feet than to supply Halifax at 3s. 6d. He therefore did not think any light would be thrown upon the question by a comparative statement showing the price of gas in Bradford and other places. Mr. Boothroyd had said he did not oppose the motion; but he thought he had, whether intentionally or not, been trailing a red herring across the scent.

Mr. BOOTHROYD: Certainly not. I shall vote for the resolution.

Alderman SCOTT was glad to hear it. If the corporation took the gas-works they would give the consumers gas for their money. The only question was whether the profits on the gas should go into the pockets of the ratepayers or into that of a private company. So far as the committee had yet had interviews with the directors, the committee had not yet seen their way to any arrangement as to the price of the works. In reply to the remarks of Alderman Brayshaw, Mr. Scott referred to the report of the committee, where it was stated that the directors had expressed their readiness to transfer the whole concern to the corporation. It was, therefore, now merely a question of price. He was sorry to say that the idea of the directors with regard to price was what he considered a very extravagant one, and he thought they stood rather in the way of the shareholders, but of that the shareholders themselves were the best judges.

The motion was then put, and carried all but unanimously.

NORTH BRITISH ASSOCIATION OF GAS MANAGERS.

ANNUAL MEETING IN EDINBURGH.

The Ninth Annual General Meeting of the North British Association of Gas Managers was held in the Hall of the Royal Scottish Society of Arts, 117, George Street, Edinburgh, on Wednesday, July 20. There was a good attendance. Mr. THOMAS WHIMSTER, engineer, Gas-Works, Perth, president of the association, occupied the chair.

The minutes of last meeting of the association, held at Glasgow, were read by the hon. sec., Mr. W. MACKENZIE, Dunfermline, and unanimously approved. Minutes of the meetings of the committee of management were also read and confirmed.

ELECTION OF OFFICE-BEARERS.

The meeting then proceeded to nominate office-bearers for the ensuing year, and the following gentlemen were proposed and unanimously elected, viz.:—

President, Mr. Hugh Bartholomew, Glasgow.
Vice-President, Mr. J. K. Watson, Edinburgh.
Members of Committee, Messrs. B. M. Macrae, Dundee; Thomas Whimster, Perth; G. F. Casiter, Dalkeith; George Boyd, Alloa.
Hon. Sec. and Treasurer, Mr. William Mackenzie, Dunfermline.
Auditor, Mr. William Fraser, Inverkeithing.

The applications of twelve gentlemen to be admitted as ordinary members of the association were next considered, and, having been duly moved and seconded, were unanimously admitted.

It was agreed that the next annual meeting be held in Edinburgh, on Wednesday, July 19, 1871.

The CHAIRMAN then said that the members were all aware that Dr. Stevenson Macadam, who had, in his usual obliging and gentlemanly way, agreed to lecture to us to-day, had all along evinced the greatest readiness to aid the association by every means in his power. This is the third time he has come forward to deliver a lecture at our annual meetings. One year we had the use of his lecture-hall, which he again offered to place at our disposal this year. He was the first honorary member elected by us, and whilst he regarded this as an honour conferred upon him, we likewise felt it to be a higher honour to the association to have such a distinguished gentleman on our roll of membership. The question of appointing Dr. Macadam as consulting chemist to this association has been considered by the committee, and approved. It would be a compliment to Dr. Macadam which he would very much value, and it would show him that we appreciate the services he has rendered the association. I have, therefore, to propose that Dr. Macadam be now appointed consulting chemist to the North British Association of Gas Managers.

Mr. ROBSON seconded the motion.

Mr. REID (Leith) said that they had received services from Dr. Macadam for several years, and they had derived much instruction from the lectures which he had given them. He was certain that that day they would have evidence of the ability of Dr. Macadam, by the way in which he would deal with the subject on which he was to lecture. I hope you will adopt the motion unanimously.

The motion was declared to be unanimously agreed to.

PRESIDENT'S ADDRESS.

The CHAIRMAN then delivered the following address:—

Gentlemen,—The duty of addressing you to-day—if it be a duty—is one which conventional usage alone has created, and the question as to whether you would be more honoured in the breach than in the observance of it on the present occasion, is one which has exercised me not a little. Yet, rather than shrink from any work which might fairly be regarded as belonging to the honourable position to which you elected me—viz., the presidency of this association—I have ventured upon a task for which I have no great confidence in my fitness.

It is well, at these our annual meetings, that inquiry should be made into the state of the association, so as to ascertain whether it be in a healthy and progressive condition; and I am glad to say that in this matter there is room for congratulation. The number of names added to our roll of membership to-day is twelve, showing an increase of over 10 per cent. on the current year. There is also another manifestation of vigorous life in the association this year. I refer to the prizes offered for essays by Messrs. Bartholomew, of Glasgow; Macrae, of Dundee; Fraser, of Inverkeithing; R. and J. Laidlaw, of Glasgow; and Hurll, Young, and Co., of Garnkirk. These gentlemen deserve the esteem of their fellow-members, and I may say of all who hold property in gas-works, for their disinterested enterprise. I have no doubt that their aim in this spirited movement will be entirely successful, and that they will thus evolve the latent knowledge and utilitarian resources of the profession to an extent far exceeding what may have been anticipated. The essays sent in are few in number, and some of them too short to be of any practical value. This need not cause surprise, as the idea of offering prizes did not occur until after the general meeting last year, and the circulars were not issued till January this year. The matter was thus placed before the managers throughout the country at their busiest season, and many of them would not have time fully to think over it until it would be too late for them to undertake such a task with any hope of success. This was unfortunate, but, as the opportunity is to be repeated, it is to be hoped that more of the members will be prepared to compete. The fact that those essays which have been sent in, have been prepared upon so short notice, speaks well for the spirit of the writers. Two of the essays have been selected for prizes; one of these is a most creditable production, and the first prize was most heartily and unanimously awarded it by the committee.

Some three or four years ago, the demand for paraffin oil, coincident with the expiry of the patent of Mr. Young, of Bathgate, suggested the idea that gas companies might profitably become manufacturers of that important article. As, in the process of the distillation of coal for the production of oil, a considerable quantity of rich gas was necessarily made, it was thought that this gas might be stored for illuminating purposes. This idea was carried into practice by the Hawick Gas Company, and for a time promised to be a successful speculation; but the fluctuation in the price of paraffin, from reasons so obvious that they need not be particularized, and to which gas is not subject, showed that this plan, though to some extent an economizer of coal, was not a safe one for gas companies; and the success of the experiment was, happily, sufficiently temporary to prevent the example being followed by more important companies, and on a larger scale. This is one of those ideas which look so very feasible before experience has disclosed their weak points, that it is not unlikely to be revived from time to time, and to prove a cause of uneasiness to gas companies.

About the same time the revival of the oxyhydrogen light "will-o'-the wisp," accompanied, as usual, by the most confident and reckless assertions—and, above all, backed by the Government of the day, in the now notorious Perth Barracks case—turned the attention of holders of property in gas-works to its threatening glare, and, no doubt, to some extent gave a feeling of insecurity in gas stock throughout the country. In that case the statements made by interested and by no means over-scrupulous parties, were eagerly manipulated by the talented artists of the newspaper press, until the old-fashioned but "beautiful for ever" chemical experiment threatened to become like the tree which Nebuchadnezzar saw in his dream, which filled the whole earth. I will not trouble you with details of this sham, in which Government money was freely spent in order to frighten the Perth Gas Company. Suffice it to say that it was a "nine days wonder," and was withdrawn as quietly as possible. These disturbing causes, though they do not look very formidable in the light cast upon them by their failure, are, nevertheless, while they are in operation, very troublesome, and have the effect of temporarily retarding the progress of improvement. There is the fear engendered that gas property may be destroyed by the introduction of some cheaper illuminating agent, and improvements which would otherwise be pushed forward are delayed until the fear is dispelled and confidence restored. At the present time there seems to be great confidence in the permanent value of gas stock, which is more especially manifested in the eagerness of municipal authorities to acquire the gas-works throughout the country.

The illuminating power of gas test is receiving very great attention at the present time, and it is to be hoped that some practical and decisive solution of the difficulty will be arrived at. No one seems satisfied with the sperm candle as a standard of comparison, and certainly, if we compare experiments made therewith, the variable results obtained are not a little confusing, and indicative of a source of error in the present mode of testing so active that little reliance can be placed in them; but it is probable that there are other and greater sources of error in the present system of testing for the illuminating power of a gas than what is found in the variable consumption of a sperm candle. Indeed, the candle seems to be the scapegoat in this case.

I have found that gas tested with the same candle and with the same burner will give widely different results under different conditions. Take the following trials in illustration, noting that they were all made with the same burner, a No. 6 union jet, and that they were all corrected to the standard consumption of 5 cubic feet per hour. No. 1 was made with the burner regulated by the stop-cock, in the usual way, immediately under the jet socket, and adjusted to a consumption of 2·69 cubic feet of gas per hour. The result obtained was 28·6 candles, the duration of 1 cubic foot, with a 4-inch flame, being 70 minutes. No. 2 was regulated by the same stop-cock, with as much gas turned on as the burner would consume without rushing in the flame or smoke, and the consumption of gas was at the rate of 4·2 cubic feet per hour. The result then obtained was 31·03 candles, the duration being the same—viz., 70 minutes. I then set the stop-cock full open, and adjusted the governor to give a full flame at the burner without rushing or smoke, and got a consumption of 5 cubic feet per hour. This gave a much better result in candles, but the light varied so much, in consequence of the unsteadiness of the meter, that the experiment could not be trusted. No. 3 was made with a stop-cock regulated by a screw and pinion, and placed upon the pipe between the governor and the burner, and about 18 inches from the latter. This gave a steady full flame at the burner without any rushing or smoke; the consumption was 5·02 cubic feet per hour, and the average illuminating power in candles was 33·6, the duration test giving 69 minutes. This proves that one great source of error arises from the quantity of gas consumed, the error in this case amounting to 5 candles. Another and an admitted source of error is a rushing or smoky flame, which will seriously influence any experiment. I think that this view of the causes of irregularity in the illuminating power test will be supported by the following observations on the duration test.

In experiments made during the present year, I have found that the duration test does not vary in consequence of the size of the orifice in the burner used. Thus, burners with the openings of the size to give a 4-inch flame with 4, 8, and 16/10ths of an inch of pressure respectively, all give the same duration of a cubic foot of the same gas, as the following table of experiments will show:—

Pressure at Gasholder, in Inches.	Pressure at Burner, in Inches.	Time Required to Consume 0·1 Cubic Foot of Gas, in Minutes.	Time Required to Consume 1·0 Cubic Foot of Gas, in Minutes.
1·7	1·6	6·50	68·3
1·7	0·8	6·51	68·5
1·7	0·4	6·50	68·3

Each of the results in the third column is the average of three experiments.

Keeping this, then, in view—viz., that a 4-inch flame of the same gas will give the same duration, whatever pressure be required to produce it—let us look at the results of experiments, as published in the analyses of the many varieties of cannel coals in which the duration test and the illuminating power test are placed side by side. A comparison of the subjoined extracts from these analyses will show a discrepancy or difference to the extent of over eight candles, supposing that the duration test is reliable, which I take it to be.

Duration of 1·0 Cubic Foot of Gas with a Flame 4 Inches High, in Minutes.	Illuminating Power of same Gas, in Candles.
64·0	24·19
64·23	21·35
66·5	32·47
67·8	24·11
73·5	25·72
73·56	28·89
77·0	32·15
82·9	33·0
83·3	39·5
86·4	35·31

It is very well known that to get a 4-inch flame from gases of different qualities, more gas must be supplied in one case than in another; the lower the illuminating power of the gas, the greater the quantity necessary to give a 4-inch flame. While working with the duration test, it occurred to me that a 4-inch flame might be of a uniform illuminating power, whatever the quality of the gas; and that, if this were found to be the case, it would be a simple matter to ascertain what height of flame would be equal in illuminating power to a candle; that this height of flame might be employed as a standard of com-

parison, and thus the gas could be always tested by itself. With this idea, I made some experiments with the following results:—

Pressure at Meter, in Inches.	Pressure at Burner, in Inches.	Duration of 1·0 Cubic Foot with 4-inch Flame, in Minutes.	Illuminating Power of 4-inch Flame, in Candles.
1·4 ..	1·1 ..	65·6 ..	2·58
1·4 ..	0·8 ..	82·5 ..	2·58
1·4 ..	1·3 ..	57·1 ..	2·25
1·7 ..	1·2 ..	78·0 ..	2·58
1·7 ..	1·6 ..	52·5 ..	2·09
1·5 ..	0·5 ..	70·8 ..	2·58

I may state that these experiments are not sufficiently verified to be put forward with confidence. You will observe that there is a perfect uniformity in the illuminating power of the gas within the range of from 65 to 82 minutes duration. At 57 minutes the illuminating power has fallen ·25; and at 52 minutes it has fallen ·49.

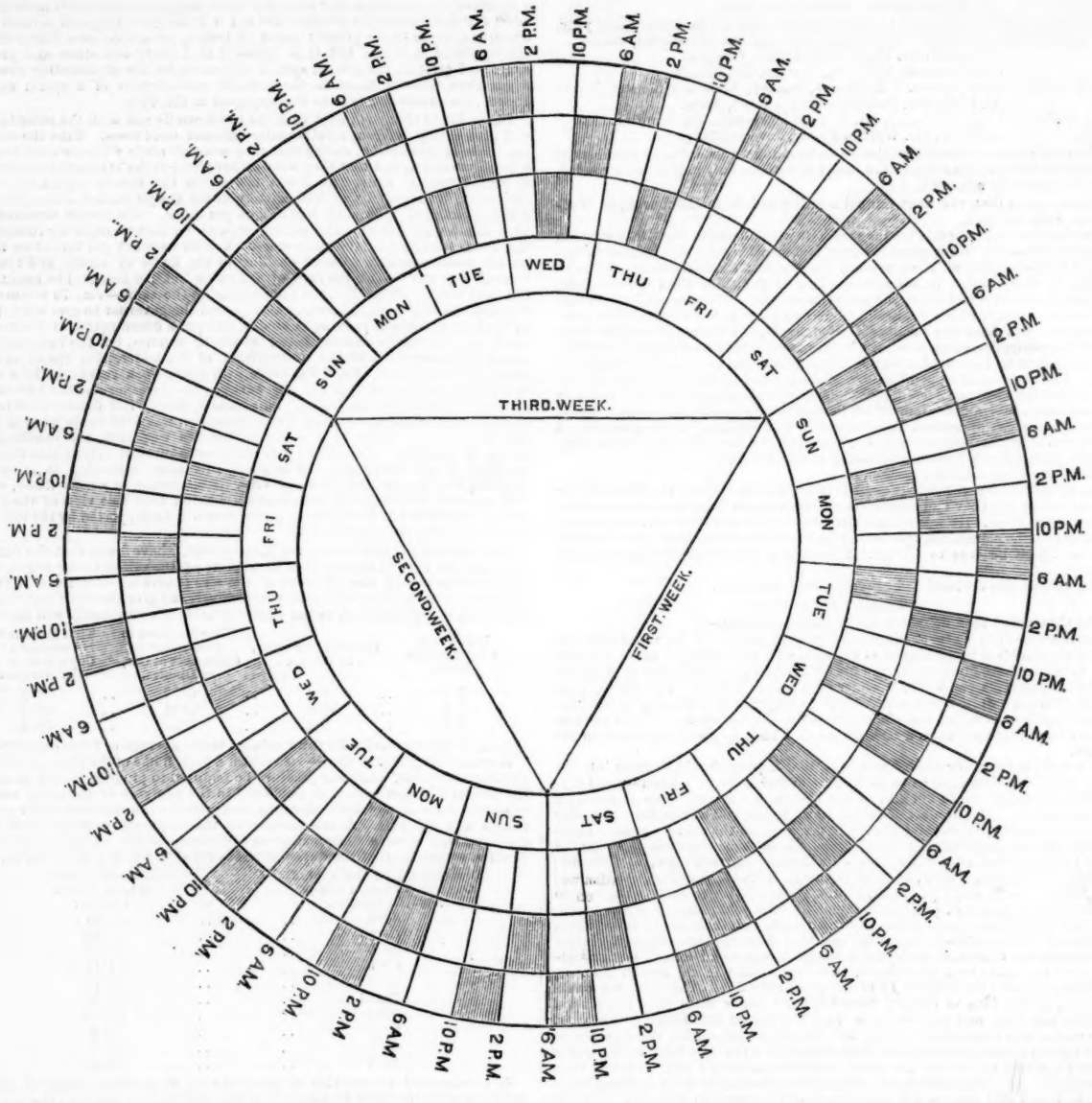
From these observations on the candle and durability tests, I would make the following deductions:—

1. The condition of the supply of the gas to the burner, and the rate at which the gas is burned in making the candle test, are great sources of error.

2. The duration test, not being subject to these, is much more reliable.

3. That standard height of flames, as a substitute for candles, with which to compare the gas, may be fixed within certain limits, or that tables of carefully made experiments might be collected to fix with almost absolute certainty the illuminating power of the gas of a given duration with a 4-inch or other standard flame. This would not only simplify the illuminating power test, but would give it a reliability which is at present a desideratum.

During the past year the question of Sabbath labour in gas-works has been put prominently forward by a committee of managers in London, who issued a circular, and addressed copies to 400 engineers and managers of gas-works. Of these, 154 were returned filled up. The replies to the questions contained in this circular disclose a very general concern on the part of managers on this important subject, which is very hopeful, and should encourage the committee to proceed in their self-imposed task. The right settlement of this question will be cause for joy and thankfulness to thousands. It is an admitted truth that not only is the Sabbath, or seventh portion of time, divinely appointed as a day of rest from toil, but that it is also a human necessity. I may here say that I look upon Sabbath labour in a gas-work as being to a certain extent necessary under present circumstances. What I regard as desirable is, not that no work shall be done from 12 p.m. on Saturday till 12 p.m. on Sabbath, but that men shall not be so overworked as to unfit them by physical exhaustion for engaging in the religious services of the Sabbath, and that they shall also have a portion of every Sabbath in their own right, and not as a boon which the manager may withdraw at pleasure, so that they may, if they so choose, receive religious instruction in the house of God upon that day. "The Sabbath was made for man, and not man for the Sabbath;" and may we not abide by the spirit, though in present circumstances we cannot adhere to the letter of the command? This I regard as the inalienable right of every human being, and yet gas companies go on ignoring the fact systematically and universally, as if it were a matter which might be dealt with to suit circumstances. It is without doubt a matter of wrong which circumstances and usage have authorized, and which the stokers have not the power to redress, nor, it may be, the will. But this is one of the fruits of the system, and for which the managers are undoubtedly responsible. I cannot go into these questions in an address like this, but must deal cursorily with the whole subject. As a rule, gas-works are not provided with sufficient gasholder accommodation to enable them to dispense to any appreciable extent with Sabbath labour in the depth of winter. Their stock of gas is exhausted on Saturday night, and Monday is devoted to scurfing retorts, so that on the Sabbath the stock must be made up—or, rather, let me say, is made up. There are, no doubt, certain gas-works which have special facilities for lessening Sabbath labour, and whose managers avail themselves o these facilities to the full—all praise to them; but it is to be feared that thfe majority of managers are indifferent on this point, or regard it as a necessity that things should remain as they are. As the committee can have no power to remedy or remove these hindrances in their way, I can only see one method of overcoming the difficulty that would be satisfactory or permanent; and that is, the adoption of eight-hour shifts, or three squads of men for the 24 hours work. If this were done the men would have the ordinary amount of labour—viz., 56 hours per week, or seven days of eight hours each, corresponding to six days of ten hours each, less the Saturday half holiday, equal to 57 hours. Thus each man would have 16 hours for sleep and rest out of the 24, and on every third week, by a proper arrangement, each squad would have the Saturday half holiday and Sabbath free for recreation, rest, and religious improvement.



In explanation of how the eight hours system may be wrought, I would call your attention to the accompanying diagram, in which the three rings represent the employment of three squads of men. The radial spaces into which these rings are divided represent eight hours each, those coloured indicating work, those blank rest. These radial spaces are collected into groups of three, representing days, which again are gathered into sevens for weeks, there being three weeks in the circle, shown by the three sides of the triangle.

The day is divided into three shifts, as marked in the diagram; the first extending from 6 a.m till 2 p.m., the second from 2 till 10 p.m., and the third from 10 p.m. till 6 a.m., and the three squads take a week of each of these

shifts alternately, so that they are at work on the same shift every third week. This allows them a portion of every Sabbath in their own right. On one Sabbath they have from 6 a.m. till 2 p.m. for rest, on another from 2 till 10 p.m., and on the third the whole day, besides the Saturday afternoon and night. For instance, following the diagram, one squad begins the first week on the Sabbath by working from 6 a.m. till 2 p.m., the remainder of the day and the night, till 6 a.m. on Monday, being their own. This continues all through the week. On the following Saturday they work till 2 p.m., as usual, but then they rest till 10 p.m. on Sabbath, being thus allowed the whole of Saturday afternoon and night, and all Sabbath till 10 o'clock at night; when they begin again, working till 6 a.m. on Monday, rest during the day, and return at 10 p.m. This continues all through the second week, at the close of which, instead of their regular 16 hours rest, they have only eight. Leaving work at 6 a.m. on Sabbath, they return at 2, and work till 10 p.m., when they again leave, to return at 2 p.m. on Monday. This continues throughout the third week, till when on Saturday—they leave at 10 p.m.—they have again only eight hours rest, returning at 6 a.m. on Sabbath, and working the fourth week the same as the first, and so on in regular rotation.

In this manner the three squads take each of the three shifts alternately, and the regular routine is 8 hours labours and 16 hours rest out of the 24; whilst when changing at the end of the week, once out of three changes, they have 32 hours rest consecutively, yet at each of the other two changes they have only 8 hours, which is equal to three intervals of 16 hours each, and never have they more than 8 hours consecutive labour.

If this arrangement were resolved upon, there would be no difficulty in the way of its adoption: one-third could be taken off the wages, say about Midsummer, and they would very soon adjust themselves, as supply and demand always do. Thus a great evil would be redressed, the righteous claims of God and our fellow-men would be met, and I doubt not that within twelve months afterwards we should be disposed to wonder that the present state of things had been submitted to so long.

Gentlemen, the subjects which were written down in my notes to be considered in this address are not yet exhausted. These were—the progress of the use of machinery in retort-house work; the process of carburetting common air as a substitute for coal gas—a process which is every now and again being protected by patent, as if it had never before been heard of; also a question which was once propounded in this association, but not answered—viz., "How far is it economical to convey gas in pipes?" These subjects I could not overtake, for, having got thus far, I found that the time allotted me was exceeded.

Before closing, allow me to thank you for the honour you have done me in electing me to the chair of this association for the past year. I was conscious from the first of my inabilty to do justice to this position, but it was hard to think meanly of myself after your unanimous vote of confidence, and being also assured, from past experience, of the gentlemanly consideration which I should receive, I accepted the appointment, and have given my best attention to its duties, and can now say, in closing, that I have done what I could.

Mr. Reid (Leith) proposed a vote of thanks to Mr. Whimster for his excellent address.

Mr. M'Crae, in seconding the motion, said he was sure that if the address was printed, and found its way into the hands of the members of the association, they would find it contained matter of the greatest importance to them.

Mr. Robb (Haddington) concurred with all that had been said in praise of the address. He rejoiced that Mr. Whimster had brought under the notice of the members of the association the question of Sunday labour in the gas-works, because this was a matter in which they were all deeply concerned. He hoped that the proposal which had been made to employ three squads of men would receive a fair trial, so that they might ascertain by next year whether it was practicable or not.

The Secretary then read the following report by the committee on prize essays:—

REPORT ON PRIZE PAPERS BY THE
COMMITTEE OF THE NORTH BRITISH ASSOCIATION OF GAS MANAGERS,
TO THE ANNUAL GENERAL MEETING OF THE
ASSOCIATION, TO BE HELD ON THE 20TH OF JULY, 1870.

As soon as practicable after receiving intimation that certain parties were desirous of giving prizes for the best papers on subjects in connexion with gas manufacture, the committee took steps to put the matter in form, and bring it before those gas managers in Scotland eligible to compete; and accordingly, at a meeting of committee, held in Glasgow on the 15th of December last, the secretary was requested to prepare a circular embodying the resolutions then come to, and send copies to each member of the association, and also to insert the same as an advertisement in the Journal of Gas Lighting, as well as in other newspapers, so that the subjects might be brought under the notice of all members of the profession in Scotland, whether connected with the association or otherwise. This, as you will be aware, has been done, and while the result, in respect of the number of papers sent in, has not been such as the committee desired, yet they are much gratified in stating that those received reflect great credit upon their authors.

The committee have decided that only one prize for each subject be awarded at present, and the awards they unanimously make as follows, viz.:—

1. "On the best Mode of Carbonizing Coal," &c., to the author of the paper bearing the motto "*Parcum in Multo*," the first prize of £10 10s.

2. "On the best Method of Constructing and Setting a Bench of Fire-clay Retorts," &c., to the author of the paper bearing the motto "*Sto*," the first prize of £6.

The committee feel confident that the present movement will tend very much to invigorate the association, and to bring forward a very considerable number of competitors for prizes which may be offered for next or future years.

The report was approved of.

(*To be continued.*)

BRITISH ASSOCIATION OF GAS MANAGERS.

The following papers presented at the last meeting of the Association were, for want of time, taken as read, and were ordered to be entered on the "Transactions":—

ON THE PRACTICAL RESULTS OF
DIFFERENT METHODS OF PURIFYING GAS, AS SHOWN IN THE REPORTS
OF THE DAILY TESTINGS OF GAS SUPPLIED TO THE METROPOLIS
DURING THE LAST ELEVEN MONTHS.

By H. Letheby, M.B., M.A., &c.,
Professor of Chemistry in the College of the London Hospital, and Chief Gas Examiner for the Metropolis.

Among the many advantages of a constant and systematic examination of the illuminating power and chemical quality of the gas supplied to the public, is the opportunity which it affords of contrasting the results of different methods of gas manufacture. This is remarkably shown in the reports of the daily testings of the gas supplied to the several testing-places appointed under the provisions of the City of London and Chartered Gas Acts of 1868; and I have classified the facts in the accompanying table, under the headings of illuminating power and chemical purity, the latter having reference to the proportions of sulphur and ammonia in the gas of each of the companies.

The average illuminating power of the Chartered gas during the last eleven months has been 16·29 standard sperm candles at Leadenhall Street, 16·26 at Gray's Inn Lane, and 16·32 at Arundel Street, Haymarket, making a general average of 16·29 candles for all the stations of the Chartered Company. The power of the gas of the City Company at Cannon Street station has been 16·75 candles, and of the Great Central Company, at Friendly Place, it has been 17·13 candles.

As regards cannel gas, the average illuminating power of the gas of the Chartered Company has been 23 standard sperm candles, and of the City of London Company it has been 25·98 candles.

The average proportions of sulphur in the common gas have been as follows:—21·59 grains per 100 cubic feet of the Chartered gas at Leadenhall Street, 25·15 grains at Gray's Inn Lane, and 28·47 grains at Arundel Street; the mean amount in the Chartered gas at all these places being 25·07 grains per 100 cubic feet. In the City of London gas it has averaged 19·75 grains, and in the Great Central gas it has been 12·51 grains. The sulphur of the cannel gas has averaged 24·59 grains in that of the Chartered Company, and 10·19 grains in that of the City Company.

The average quantity of ammonia in the common gas of the Chartered Company has been 2·82 grains per 100 feet at Gray's Inn Lane, 3·1 grains at Leadenhall Street, and 4·08 grains at Arundel Street; the mean amount at all these places having been 3·34 grains. The common gas supplied by the City Company has been always quite free from ammonia, while that of the Great Central Company has averaged only 0·73 of a grain of ammonia per 100 cubic feet.

The cannel gas of the City Company has also been at all times free from ammonia, the proportion in the Chartered Company having been 2·53 grains per 100 feet.

It is right to observe that the several testing-stations at which the gas of the several companies is examined are all as near as may be to 1000 yards from the works; and it will be remarked that the quarterly averages of the impurities are nearly the same in each particular case, showing unquestionably that the results are entirely due to different methods of purification; and this is the practical point to which I am anxious to direct your attention.

I am not well acquainted with the details of the system of purification adopted by the Chartered Company at their several stations, but it is manifest that the condensing power is defective, and that the means of removing sulphur is not as perfect as it might be.

At the works of the City Company, where the whole of the ammonia is entirely removed from the gas, and where the proportion of sulphur is less than 20 grains per 100 cubic feet, the gas is purified by means of five large scrubbers, the invention of their talented engineer, Mr. Mann. Each scrubber presents a large surface of moistened coke for the absorption of ammoniacal compounds. Water is delivered at the top of the scrubbers from a series of revolving jets, which discharge the water at the rate of 1 gallon for every 1000 feet of gas, on to a horizontal revolving tray covered with birchwood, and thereby distributed evenly over the coke; and as the gas rises against the downward flow of water, it is deprived of all its ammonia, and of much sulphuretted hydrogen, so that the liquor leaves the scrubber of a strength of 14 ounces of strong sulphuric acid. In this way the amount of ammoniacal liquor has been increased from about 9 gallons per ton of coals to 22 gallons, the average strength of it as it leaves the works being equal to 10 ounces of commercial acid per gallon of liquor. Mr. Mann has given a full description of the apparatus in the Journal of Gas Lighting for the 31st of March, 1868.* After leaving the scrubber, the gas is purified by means of lime and oxide of iron.

At the Great Central Gas-Works, which are under the management of Mr. Harris, the ammonia is removed from the gas by a series of three large scrubbers, the first two being charged with a stream of ammoniacal liquor, and the third with water. The gas is then passed through a series of dry lime purifiers, which present a very large surface for absorption, and the lime is purposely left in the purifiers after it has become foul, and until a good deal of the sulphuretted hydrogen first absorbed is displaced by carbonic acid. In this manner the natural affinity of sulphide of calcium for bisulphide of carbon is permitted to act, and much sulphur, in this objectionable form, is retained. Leaving the lime purifiers, the gas, which is still charged with more or less of sulphuretted hydrogen, is passed through oxide of iron.

These operations, especially at the Great Central works, are most instructive, for they show that with proper management a large yield of ammoniacal liquor of good commercial strength may be ensured. At the City works it amounts, as I have said, to 22 gallons, of 10 ounces strength, per ton of coals, and at the Great Central works it is 20 gallons, of from 10 to 11 ounces strength, per ton. When I had the honour of lecturing to this society at its meeting at Birmingham, in 1865, I dwelt particularly on the importance of removing all trace of ammonia from gas before it is delivered to the public, and I instanced the works of the Birmingham and Staffordshire Gas Company, at Saltley, where, by the excellent management of the engineer, Mr. Young, the amount of liquor obtained per ton of Staveley coal is 44 gallons of from 7 to 8 ounces strength. This is effected by copious washing of the gas with water and weak liquor, without injury to the illuminating power, and the commercial result is a profit of more than £2000 per annum above the ordinary return for liquor.

The chemical effect of these operations is very intelligible, for sulphide of ammonium and sulphide of calcium are both endowed with the power of combining with bisulphide of carbon, and therefore of absorbing and fixing this objectionable impurity. It is manifestly, then, of the greatest importance that coal gas should be kept in contact with these substances as long as possible during the process of purification. In the case of ammoniacal liquor, it should be effected by a great length of pipe from the hydraulic main to the condenser, and the condensation of tar and liquor should be perfect. The gas should then be scrubbed with liquor, so as to bring the liquor to not less than 14 or 15 ounces strength, and Mr. Mann's double scrubber is excellently well suited for this purpose. In the case of sulphide of calcium, it should be permitted to act for some time after the lime has become foul, for it is in this condition that it is most effective, and a lime purifier should not be changed until the sulphuretted hydrogen of the foul lime is largely displaced by the carbonic acid of the raw gas. If it be necessary to use oxide of iron, on account of the difficulty of disposing of foul lime, it should be used after the lime.

Looking at the results of the testings in London, it would seem that gas purified in an ordinary way contains about 25 grains of sulphur, and from 3 to 4 grains of ammonia per 100 cubic feet of gas, but that if pains are taken to remove all the ammonia by a process which keeps the sulphide of ammonium in contact with the gas for some time, the proportion of sulphur declines to less than 20 grains per 100 cubic feet, in the case of common gas, and to about 10 grains in cannel gas; and that if, as at the Great Central works, sulphide of calcium, or foul lime, is also used as an agent of purification, the proportion of sulphur is reduced to 12·5 grains per 100 feet, as was the proportion in gas in the old days of lime purification.

It will be noted that these processes of purification are effected without loss of illuminating power, for the only hydrocarbon which is likely to be removed from the gas with the ammonia is naphthaline, and this is certainly better out of the gas than in it; wherever, in fact, ammonia is thoroughly removed from

* Mr. Mann has since proposed that the scrubber should be 48 feet in height instead of 24, and that the water should be delivered at the rate of half a gallon per 1000 cubic feet of gas instead of 1 gallon. By this arrangement, which he calls a double scrubber, the liquor will acquire a maximum strength, and will thus be in the best condition to remove, by absorption and chemical combination, the bisulphide of carbon from the gas. This, in my opinion, is a very effective arrangement, and will prove of great service in the purification of gas, for it is strictly in accordance with the principles of both theory and practice.

coal gas, there is no complaint of the mischief arising from the deposit of naphthaline. At the Birmingham and Staffordshire works, for example, this impurity is entirely unknown, and so also is the corrosive action of ammonia on the copper fittings of meters and service-pipes.

It has occurred to me that these facts would have a practical as well as a commercial interest for you.

AVERAGE ILLUMINATING POWER AND CHEMICAL PURITY OF THE GAS SUPPLIED TO THE METROPOLIS BY THE CHARTERED, THE CITY OF LONDON, AND THE GREAT CENTRAL COMPANIES DURING THE LAST ELEVEN MONTHS.

Illuminating Power in Standard Sperm Candles.

		Quarter ending Sep., 1869.	Quarter ending Dec., 1869.	Quarter ending Mar., 1870.	April and May, 1870.	Entire Year.
Chartered common gas.	Leadenhall Street.	14·96	14·78	17·84	17·60	16·29
	Gray's Inn Lane .	15·63	15·69	16·70	17·04	16·26
	Arundel Street. .	15·47	14·98	17·60	17·22	16·32
Average of Chartered common gas		15·35	15·15	17·38	17·19	16·29
Ditto City of London ditto . . .		16·08	16·26	16·95	17·77	16·75
Ditto Great Central ditto . . .		15·69	17·55	17·46	17·82	17·13
City of London cannel gas . . .		24·58	25·07	26·09	28·19	25·98
Chartered ditto		21·66	21·71	24·12	24·51	23·00

Grains of Sulphur per 100 Cubic Feet.

		Quarter ending Sep., 1869.	Quarter ending Dec., 1869.	Quarter ending Mar., 1870.	April and May, 1870.	Entire Year.
Chartered common gas.	Leadenhall Street.	17·35	23·73	22·47	22·83	21·59
	Gray's Inn Lane .	25·97	24·46	24·43	25·75	25·15
	Arundel Street. .	25·44	29·94	29·31	29·21	28·47
Average of Chartered common gas		22·92	26·04	25·40	25·93	25·07
Ditto City of London ditto . . .		19·75	19·71	19·99	19·56	19·75
Ditto Great Central ditto . . .		12·71	12·47	14·19	10·66	12·51
City of London cannel gas . . .		8·63	10·29	9·54	12·31	10·19
Chartered ditto		24·10	23·47	25·88	24·93	24·59

Grains of Ammonia per 100 Cubic Feet.

		Quarter ending Sep., 1869.	Quarter ending Dec., 1869.	Quarter ending Mar., 1870.	April and May, 1870.	Entire Year.
Chartered common gas.	Leadenhall Street.	3·42	3·84	1·48	3·66	3·10
	Gray's Inn Lane .	None.	0·73	0·86	3·68	2·82
	Arundel Street. .	6·94	3·36	3·28	2·80	4·09
Average of Chartered common gas		3·45	4·64	1·87	3·38	3·34
Ditto City of London ditto . . .		None.	None.	None.	None.	None.
Ditto Great Central ditto . . .		1·31	1·01	0·21	0·38	0·73
City of London cannel gas . . .		None.	None.	None.	None.	None.
Chartered ditto		3·30	2·68	2·10	2·04	2·53

NOTE.—Prior to the 1st of January, 1870, the illuminating power of the common gas, as prescribed in the City of London Gas Act, 1868, was 14 standard sperm candles, but since then it has been 16 candles.

REMARKS ON THE BURNERS USED IN TESTING THE ILLUMINATING POWER OF COAL GAS.

By CHAS. HEISCH, F.C.S.,

Lecturer on Chemistry at the Middlesex Hospital, and Gas Examiner to the Corporation of the City of London.

A slight error has been made in the title which has been published of this paper, which makes it more pretentious than I intended; it should have been as above. I must apologize for the somewhat crude state of these remarks, but when I tell you that, owing to having been obliged to move my laboratory, all my gas apparatus has been for some months in the hands of one of those necessary evils, an instrument maker, and that instead of receiving it as promised, two months ago, I only got it last week. I feel sure you will sympathize with my condition, and pardon my shortcomings.

The question, What should be the definition of a test-burner? has always been a vexed one; and, as far as I know, all the so-called definitions yet given have been so vague that burners of very different kinds might be and have been included under them. Putting aside altogether the commercial view of the subject, as in discussions of this kind I think we are bound to do, there are two points on which I think we shall be all agreed—1st, that the burner should be so defined as to be unmistakable; 2nd, that all experiments made with it should, if possible, be strictly comparable, no matter what be the quality of the gas. The question of whether or not a test-burner is fit for the consumer's use is, I think, of very small importance abstractedly. If it fulfil the purpose of a test-burner well, its relations to the various burners used by consumers will soon be made out. Now, if we turn for a few moments to the burners which have at different times been used as test-burners, we shall see how very far they are from fulfilling either of the conditions specified above. Here is a burner (Platow's Patent Argand) which was some years ago proposed, and by some used, as a test-burner. It is an Argand with 15 holes, and burns 5 cubic feet of gas well with a 7-inch chimney, so it corresponds with the old definition of a test-burner, but it was objected to on the ground that it had a cone; nevertheless it is a very good burner. In the days of which I am now speaking gas was not in London what it is now, or was not supposed to be, and this burner gave a light of something over 12 candles. Then came Dr. Letheby's test-burner, also an Argand with 15 holes, and this same gas became of 14-candle power; and last year, the old definition having been abandoned, we had Mr. Sugg's London Argand, and the gas became 16-candle gas. In fact, when the illuminating power of a gas was stated it conveyed no real meaning at all. But going a step further we come to a still more extraordinary state of things. At the beginning of the present year certain companies were bound to increase the illuminating power of their gas, but when they did so this same London Argand would not properly burn 5 feet an hour, and the gas was reported sometimes no better, and sometimes worse than it had been. A chimney of larger diameter was then used, and finally one of increased length also; but even thus the gas was imperfectly burnt, and its real illuminating power was much under-stated. All this time cannel gas had been tested with a bat's-wing burner, and it occurred to me to try the ordinary gas with the same burner; and in the table appended you have the results, which are very instructive, as showing the varying relation in the light given by these two burners with gas of different qualities. When the gas is of low quality, the Argand is very much higher; where it is of high quality, the bat's-wing gives the best results. In fact, with the London Argand, with a chimney of 2 inches diameter and 7 inches long, we may have two 16-candle gases, one really about 2 candles better than the other. The are easily distinguished, as the flame of one is much whiter than that of the candles, whilst the flame of the other is quite yellow as compared with them. In none of these experiments the gas talled over the chimney. We have, then, the following different kinds of gas, all called 16 candles when tested by the London Argand in its different states of development:—

1. The 14-candle gas of the Letheby burner, which becomes 16-candle when burnt in the London with a chimney 1¾ inch wide and 6 inches long, and burns well.

2. A gas too rich for this, but which burns well in the same burner, with a chimney 2 inches diameter and 6 inches long, but is still only 16-candle gas.

3. A still richer gas, which, with the same burner, requires a chimney 2 inches diameter and 7 inches long, but is again only 16-candle gas.

We will say nothing at present of the yellow burning gas, which is almost too rich for this arrangement, but which is another specimen of 16-candle gas.

Now, if we test the three kinds of gas just spoken of by a good bat's-wing burner, even though it be constructed with no special precautions, we find that they have about the following relations—13, 16, and 18 candles, which surely expresses much more nearly the real relative values of the gas.

If we now go a step backward and try the relation which exists between the present test-burner, with its long chimney, burning the gas at present supplied, and the older test-burners, we find that the Letheby and Platow's have, to a certain extent, changed places, the lights being respectively—London Argand, 17; Platow, 16·7; Letheby, 15·1, as a mean of many experiments.

Under these circumstances, it seems to me that a gas manager has no choice left but to make his gas to the test-burner, rather than take account of its real quality.

Having thus brought prominently before you the very unsatisfactory state of the question at present, I would make a few remarks on what I believe to be the direction in which to seek for a remedy.

Were it possible to establish any simple relation between the quantity of gas burnt and the light given the problem would be much simplified. If we strictly defined all the dimensions, &c., of a burner, and then burned through it just that amount of gas that would pass at a given pressure, we should be able to calculate to a uniform quantity. But at present no such simple relation has been made out.

All of you doubtless read a paper, which was much extolled before its publication, by Professor Silliman, in which he announced that the light given by gas varied as the square of the consumption. Putting on one side some very gross errors in principle, which one would hope were the printer's rather than the professor's, the results quoted by no means bore out the theory; but as the experiments contained one fundamental source of error—viz., using the same burner for all consumptions, which is manifestly not burning the gas under comparable conditions, I thought it worth while to make a series of experiments in which this error should be eliminated. These were made with Sugg's lava bat's-wing burners, as their conditions are more easy to ascertain than those of Argand's. One burner having been fixed on as the standard, it was made to burn 5 feet per hour. All the others were then made to burn the amount of gas that passed them at the same pressure, and the result was that the light calculated from the square of the consumption was not nearer the truth than that from the direct ratio; in fact, when about 4·5 feet were burnt, the one was just about as much too high as the other was too low. Either might be represented by a curve, but it would not be one which could readily be applied in practice. The suggestions I would venture to make are these:—

1. No burner should be admitted as a test-burner in which the conditions of pressure, &c., under which the gas is burned are not known.

2. (My next suggestion will, I know, be received by many as rank heresy; but we are here to discuss things freely in the search for truth.) That, considering the almost imperceptible differences in the various parts of an Argand burner, or its chimney, which make a material difference in the results of the testing, Argand burners should no longer be used as test-burners. I am quite aware that by giving up these burners we should give up the advantage of steadiness, and perhaps some others; but, if we obtain even an approach to uniformity, I, for one, would willingly do so.

3. That a series of bat's-wing burners should be made, the external and internal diameters of which should be precisely identical; the material of which they are constructed and its thickness be identical; the depth of the slot in all identical; the width of the slot so varied that one may be readily selected which will deliver 5 cubic feet of the gas to be tested under a given pressure, or so near it as that the difference shall be of no practical importance. I may mention that I have found by experiment that a difference of ·03 pressure in bat's-wing burners, otherwise alike, makes no appreciable difference in the light they produce. I had hoped to lay before the meeting some experimental proofs that with burners thus constructed strictly comparable results might be obtained with gases of almost any composition; but owing to the circumstances before spoken of, I have been interrupted in the middle of the experiments, and must hope to detail the results at a future time. Meanwhile, if I have succeded in calling the attention of those most interested fairly to the subject, or have offered one suggestion of practical use, my purpose will have been answered.

The following table shows the relation of the illuminating power of various qualities of gas, as determined by Sugg's London Argand with chimney 2 inches diameter and 7 inches long, and Sugg's No. 7 Lava bat's-wing, each burning 5 feet per hour:—

Bat's-wing in Candles.	London Argand in Candles.	Bat's-wing in Candles.	London Argand in Candles.
12·1	15·6	18.0	16·4
16·3	16 9	18·0	16·6
16·6	16·2	18·1	16·8
16·7	16·4	18·1	17·1
16·7	16·7	18·2	17·0
16·8	16·4	18·2	17·0
17·1	16·3	18·3	16·7
17·2	16·6	18·3	16·7
17·2	16·6	18·4	16·7
17·3	17·3	18·6	16·5
17·4	16·7	18·6	16·3
17·5	17·4	18·9	17·1
17·6	16·0	19·0	17·4
17·8	16·8	19·2	18·2
17·8	16·3	19·3	17·8
17·8	17·2	19·3	17·4
17·8	17·2	19·6	18·0
17·9	16·9		

ON ARTIFICIAL ALIZARINE.

By W. T. FEWTRELL, F.C.S.

The short paper I have the honour to submit to the association is merely intended as a sort of appendix to the exhaustive lecture "On the Utilization of the Waste Products of the Manufacture of Gas," delivered by Dr. Letheby to the association at Nottingham, in 1867, and it describes the only important addition made to the industry of gas products since the date of that lecture.

Natural alizarine, as no doubt all here well know, is a colouring matter derived from the madder root. Chemists have differed a good deal as to the exact composition of alizarine; but the researches made with the artificial product leave no doubt that its constitution is accurately expressed by the formula

$$C_{14} H_8 O_4,$$

which is very nearly the same as that given some years ago by Dr. Schunck, of Manchester.

Now, on referring to the elaborate table of constituents of coal tar given in Dr. Letheby's lecture, the reader will see among the neutral bodies the name of anthracene, which, according to the chemical notation now in use, has the formula

$$C_{14}\,H_{10},$$

and, therefore, anthracene differs from alizarine only by wanting four atoms of oxygen, and containing an excess of two atoms of hydrogen.

In the distillation of coal tar, anthracene passes over with the heavy oils. The amount of it present in the tar is not well known. The quantity is generally assumed to be very small; but Mr. Perkin states that, from experiments he has made, he has been led to believe that the tar contains considerable quantities of anthracene.

In a table given by Dr. Roscoe, the products obtained from 100 tons of tar are set down as follows. The quantities are given as the average results of a series of experiments carefully made by a large tar distiller. One hundred tons of tar yield on distillation—

	Naphtha.	Light Oils and Carbolic Acid.	Heavy Oils, Naphthaline, Anthracene.	Pitch.	Water and Loss.
1	3·0	1·5	35·0	50	10·5
2	3·0	0·8	25·0	60	12·2

Tar distillers have, as yet, had but little experience in the separation of anthracene, and, as I have said, the amount contained in the tar is not well known. We may be certain, however, that it is a variable quantity, the amount of it produced depending upon a variety of circumstances, among others, the nature of the coals used, and the heat at which they are distilled.

In one experiment mentioned by Dr. Roscoe, the amount obtained from one ton of tar was only 0·63 of a ton of anthracene, which must not, however, be supposed to be all there was in the tar. Much, no doubt, was left in the pitch.

The circumstance that led Graebe and Liebermann, the first producers of artificial alizarine, to look to anthracene as a source of that body, was the fact they discovered, that the destructive distillation of natural alizarine yielded anthracene. The suggestion was obvious that alizarine might possibly be produced from a body so nearly allied to it in composition. Curiously enough the first step towards this transformation had been made several years ago (in 1861) by Dr. Anderson, of Glasgow, who, by treating anthracene with nitric acid, produced an oxygenated compound of that body, to which he gave the name oxyanthracene, but which now, in accordance with more modern chemical ideas on the classification of bodies, is called anthraquinone.

The composition of this body is expressed by the formula

$$C_{14}\,H_8\,O_2,$$

which shows that we have gone so far towards alizarine as the abstraction of the two atoms of hydrogen, and the addition of two of the four necessary atoms of oxygen. To complete the transformation another process is required, which results in chemical changes of some complexity. I shall pass over the method pursued by Graebe and Liebermann, the original discoverers, and only mention briefly that pursued by Mr. W. H. Perkin, F.R.S., to whom belongs the merit of having devised a process so easy and cheap as to have already made artificial alizarine an industrial product, and not a chemical curiosity. The process adopted by Mr. Perkin is, first of all, to treat the anthraquinone with strong sulphuric acid, by which means a sulpho-acid—disulpho-anthraquinonic acid—is produced. When this substance is heated with potash it is split up, and forms sulphite of potash, and a compound of alizarine and potash; and on decomposing this latter compound with an acid a bright yellow precipitate is obtained, which is the desired alizarine nearly in a state of purity. The broad result of the chemical changes occurring in these latter stages of the process is the addition of two atoms of oxygen to the anthraquinone; but, strictly speaking, this addition is effected by the substitution of two atoms of hydroxyl (H O) in the potash for two atoms of the hydrogen in the anthraquinone.

The foregoing, I need hardly say, is only a description of the chemical changes by which the transformation of the anthracene into alizarine are brought about. The manufacturing details of the process are naturally kept secret. In describing the changes, I have purposely avoided the somewhat abstruse chemical considerations involved in the scientific elucidation of the processes, and have preferred a broad statement of the facts, such as I have supposed would be most intelligible to, and possessed most interest for, my hearers.

A comparison of the physical and chemical properties of the natural and artificially produced alizarine leaves no doubt that the two substances are absolutely identical. They crystallize in the same form, they behave in exactly the same way with reagents, and they have the same action on light.

Every discovery of this kind naturally enhances the value of gas products, and therefore possesses a special interest to gas managers. The time may come when it will be of as much importance to conduct the manufacture of gas with a view to the quality of tar as to the quality of the gas produced. In the present case there is a peculiar interest in the fact of one of the tar products hitherto considered of little value, and condemned with ignoble associates to the humble duty of lubricating machinery, being now made the starting-point for the production of one of the most beautiful dyes that gladden our sight.

The discovery I have described is probably destined to produce as great changes in the madder trade as the aniline dyes have made in the cochineal and other trades. Up to the present time we have imported and used madder in this country at the rate of about a million sterling a year. But as the artificial replaces the natural dye, it is only reasonable to believe that some part of this million will remain at home for the benefit of gas producers.

To be continued.)

REDUCTIONS IN THE PRICE OF GAS.—The Maidstone and the Rochester and Chatham Gas Companies have announced their intention to reduce the price of the gas supplied by them from 4s. to 3s. 6d. per 1000 feet.

INCREASE IN THE ASSESSMENTS OF THE SOUTH METROPOLITAN AND SURREY GAS-WORKS.—Under the new Assessments Act, Camberwell has raised the assessment of the South Metropolitan Company from £7000 to £12,000, and Rotherhithe that of the Surrey Company from £3000 to £11,000. Appeals are threatened against both assessments.

DR. WHITMORE'S REPORT ON THE QUALITY OF THE WATER SUPPLIED IN ST. MARYLEBONE, IN JULY, 1870:—

July, 1870.	Total Solid Matter in degrees or grains per Imperial gallon.		* Loss by Incineration of Solid Matter in previous column.		Ammonia.
	July, 1869. 0°	July, 1870. 0°	July, 1869. 0°	July, 1870. 0°	0°
Distilled Water . . .					
West Middlesex water .	16·28	16·24	0·64	0·60	—
Grand Junction water .	16·44	16·57	0·56	0·62	—

* The loss by incineration represents the amount of organic and other volatile matters contained in an Imperial gallon (70,000 grains) of water.

DR. WHITMORE'S REPORT ON THE QUALITY OF THE GAS SUPPLIED IN ST. MARYLEBONE, IN JULY, 1870:—

July, 1870.	Illuminating Power in Sperm Candles.			Mean Pressure in Tenths of an Inch.		Mean Quantity of Sulphur in 100 Cub. Ft.	Mean Quantity of Ammonia in 100 Cub. Ft.	Sulphuretted Hydrogen.
	*Mean of 21 Obser.	Highest.	Lowest.	Highest.	Lowest.	Grains.	Grains.	
Imperial Company's gas . . .	16·50	17·47	15·46	25·33	10·06	28·17	2·01	None.
Chartered Company's common gas	16·06	16·99	15·50	30·74	13·83	30·31	2·92	None.
Chartered Company's cannel gas	22·46	23·46	21·92	27·35	13·17	29·87	2·71	None.

Mean of daily readings of Barometer . . . 29·81
" " " Thermometer . . 73·96

* Each observation consists of 10 readings of the photometer, at intervals of one minute.

During the month, the Imperial Company's gas gave a mean illuminating power equal to the light of 16½ sperm candles, and ranged between 17·47 and 15·46 candles. On five occasions it exceeded 17 candles. The mean amount of sulphur in 100 cubic feet of this gas was 28·17 grains, and of ammonia 2·01 grains. The illuminating power of the Chartered common gas was equal to the light of 16 candles; on fourteen occasions it was below the standard required by law, but never to more than the extent of half a candle. The quantity of sulphur impurity in 100 cubic feet of this gas was 30·31 grains, and of ammonia, 2·92 grains. The mean light of the cannel gas was equal to 22½ candles, and ranged between 21·92 and 23·46 candles; its sulphur impurity amounted to 29·87 grains, and ammonia to 2·71 grains. The presence of sulphuretted hydrogen was on no occasion detected in either of the gases. The pressure of all was uniformly good. The above results where obtained from the gas manufactured by the Imperial Company at their Fulham works, and from the Chartered Company's gas, manufactured at their works, Horseferry Road, Westminster.

DR. FRANKLAND'S ANALYSIS OF THE METROPOLITAN WATERS IN JULY, 1870.—"Royal College of Chemistry, July 30, 1870.—Sir, I have the honour to submit to you in the following table the results of the chemical examination of the waters supplied to the metropolis during the month of July. For the purpose of comparison, I append also the results yielded by the waters supplied to Birmingham, Manchester, and Reading, and by Thames water taken at Battersea Bridge at low and high water on the 1st of March. All the waters delivered in London were clear and transparent except that of the East London Company, which contained brown particles and filaments, amongst which living organisms were observed. Of all waters delivered in the metropolis, that supplied by the Kent Company from chalk wells contained by far the smallest proportion of organic elements. Of the waters drawn from the Thames, that delivered by the West Middlesex Company contained the smallest proportion. By being submitted to Clark's softening process, the Grand Junction Company's water was not only reduced in hardness from 17·6° to 3·6°, but the organic matter was also removed to the extent of about one-third. The patent for this process has expired, and all water companies are free to follow the example of the Caterham, Tring, Canterbury, and other companies in the softening and purification of water by this simple operation. Dr. Hill reports that the water delivered in Birmingham was slightly turbid when drawn from the company's mains. I beg again to direct your attention to the good quality, *for bathing purposes*, of the Thames as it passes through London, after its water has undergone sand filtration, as shown by the analyses in the accompanying table. The river current would afford power for effecting this filtration, and public floating baths established on the Thames, through which a constant current of filtered water was made to pass, would be much superior, both as regards convenience and purity of water, to the best bathing attainable in the Serpentine. There is now no reason why swimming-schools for both sexes should not be established on the Thames similar to those which exist in all the chief cities of Europe. Thus a public sanitary boon would be conferred upon the metropolis, and the disgraceful scenes on the banks of the Serpentine would be rendered unnecessary.

Companies.	Date and Place of Collection.	Temperature in Centigrade Degrees.	Total Solid Impurity.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen, as Nitrates and Nitrites.	Total combined Nitrogen.	Previous Sewage or Animal Contam. (Estimated).	Chlorine.	Total Hardness.
Thames.											
Chelsea.....	July 13—Cab Rk., Horse Guards.	19·4	22·98	·121	·025	·000	·094	·119	620	1·75	18·08
West Middlesex.....	July 13—Cab Rk., Portland Road.	20·6	23·22	·112	·024	·000	·097	·121	650	1·70	17·82
Southwark & Vauxhall..	July 13—Cab Rk., St. George's Ch.	21·1	23·00	·127	·028	·000	·105	·133	730	1·70	18·08
Grand Junction.....	July 13—Cab Rk., Woodstock St..	19·4	23·02	·123	·023	·000	·091	·114	590	1·70	17·36
Do., softened by Clark's process....	July 11—Lancaster Gate, Hyde Park.....	..	10·00	·080	·022	·000	·116	·137	830	1·65	3·57
Lambeth....	July 13—Cab Rk., Lambeth Road.	19·7	23·00	·142	·032	·000	·100	·138	740	1·67	18·08
Other Sources											
New River...	July 13—Cab Rk., Totnhm. Ct. Rd.	20·3	23·16	·119	·016	·000	·140	·156	1080	1·58	18·34
East London.	July 13—Slater's, Old Ford Road.	19·4	23·46	·091	·022	·000	·014	·036	0	1·80	17·04
Kent.....	July 13—Deptford Bdge. Police Sta.	16·1	39·72	·044	·009	·000	·460	·475	4340	2·40	27·22
Thames water, filtered..	Mar. 1, 1870—Battersea Br., midstr., at low wat.	..	30·64	·451	·060	·024	·498	·573	4810	1·75	25·85
	At high water	..	32·20	·476	·048	·075	·364	·469	3940	2·05	25·02
Birmingham*	July 5, 1870—Bir. Wr. Sup.	..	49·60	·308	·069	·002	·172	·242	1420	5·32	25·14
Manchester..	Jan. 29, 1870—Man. Wr. Sup.	..	5·74	·070	·007	·001	·000	·008	0	·80	2·48
Reading.....	March 18, 1870—Read. Wr. Sup.	..	25·90	·205	·017	·001	·137	·155	1060	1·25	22·84

* Analyzed by Dr. Alfred Hill, of Sydenham College, Birmingham.

"The Registrar-General, &c." "E. FRANKLAND.

Average Composition and Quality of the Metropolitan Waters, in August, 1870.—The following are the returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total Solid Matter per Gallon.	Oxygen required by Organic Matter, &c.	Nitrogen.		Hardness.	
			As Nitrates, &c.	As Ammonia.	Before Boiling.	After Boiling.
Thames Water Comps.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Grand Junction	15·97	0·069	0·075	0·001	13·0	2·8
West Middlesex	16·87	0·049	0·110	0·000	13·9	3·0
Southwark and Vauxhall	16·95	0·073	0·075	0·005	13·9	3·3
Chelsea	16·90	0·091	0·091	0·001	13·8	3·0
Lambeth	17·77	0·063	0·060	0·001	14·2	3·6
Other Companies.						
Kent	27·19	0·001	0·125	0·000	19·8	5·7
New River	15·83	0·018	0·075	0·000	12·8	2·6
East London	15·89	0·054	0·110	0·000	12·9	3·0

Note.—The amount of oxygen required to oxidize the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and, in the case of the metropolitan waters, the quantity of organic matter is about eight times the amount of oxygen required by it. The water was found to be clear and nearly colourless in all cases.

H. Letheby, M.B.

Register of New Patents.

2276.—Thomas Parsons, of the state of Massachusetts, U.S.A., for "*A new and useful mechanism, apparatus, or engine, to be used either in measuring water discharged from a conduit, or for various other useful purposes.*" A communication. Patent dated July 27, 1869.

These improvements comprise a main cylinder, its ports, piston, and valve, an auxiliary piston and cylinder, and a mechanism for operating the latter piston by the piston of the main cylinder while in movement within such cylinder, the whole to be operated by water or other fluid under pressure while passing through the apparatus. The invention consists in the peculiar mechanism or combination of parts, by which the auxiliary piston and the valve are put in operation by the main piston. Also in an arrangement of the auxiliary piston and cylinder with the main valve, the main cylinder, and its valve-chest.

2277.—Daniel Thomas Bostel, of 21, Ship Street, Brighton, in the co. of Sussex, plumber, for "*Improvements in what are known as dry earth-closets.*" Patent dated July 27, 1869.

In carrying out this invention there is placed at some distance below the opening through the seat of the closet a horizontal or nearly horizontal pan or table for the soil to fall on to, and the closet is so arranged that, by pulling up a handle as in an ordinary water-closet or otherwise, a scraper shall be caused to move across the pan to remove the soil therefrom into a shoot, by which the soil is to be conveyed away, and also a supply of dry earth or powdered charcoal, or other dry powdered deodorizing material, is delivered to the shoot, and also (when the scraper moves back) on to the surface of the pan on to which the soil falls. For this purpose a scraper of a rod or plate is formed, carrying a strip of vulcanized india-rubber; the rod or plate at its ends rests on guides parallel with the surface of the pan on to which the soil falls, whilst the bottom edge of the india-rubber strip rests against the surface of such pan. The apparatus employed for giving motion to the scraper is also arranged for giving motion to two slides in a pipe or shoot, by which the dry earth or other dry powdered material is led from a cistern or reservoir to the closet. The space between the two slides serves as a measure to supply a measured quantity of earth or other material to the closet each time the handle is raised or the closet used. When the handle is raised the top slide is closed whilst the lower one is opened, so that the measured supply of earth or other material is allowed to fall to the shoot, and at the same time fills a horn-shaped shoot, which, when the scraper is moved back, discharges on to the pan, and the closet is then again ready for use.

2309.—Thomas Ramsay, of Sherburn Tower, Gateshead, in the co. of Durham, gentleman, for "*Improvements in apparatus for the manufacture of gas.*" Patent dated July 31, 1869.

This invention has for its object improvements in apparatus for the manufacture of gas.

In the manufacture of gas it is usual to charge the retorts at the ends, the covers being removed and the charges thrown in with shovels or scoops or machinery.

According to this invention apertures are formed in the tops of the retorts, and from these apertures tubes or passages lead up to the top of the furnace, and are there closed with suitable stoppers, which are removed when charging. It is preferred that the retorts should be formed with short charging-tubes branching out from them; and the ends of such tubes are formed with flanges, to which other tubes leading up to the top of the furnace may be connected. Railways or tramways are provided over the furnaces, on which trucks with hopper-like bottoms run. The charges of coal or other gas-making material are placed in these trucks, and are carried by them over the charging-tubes or passages of the retort; the coal or material is then discharged through a slide trap at the bottom of the truck, and falls into the retort. It is levelled and spread by tools introduced from the end of the retort. The gas may be conducted off by the charging-tubes or passages.

2313.—Paul Rapsey Hodge, of 10, Adam Street, Adelphi, in the parish of St. Martin's-in-the-Fields, in the co. of Middlesex, civil engineer, for "*Certain improvements in the manufacture of luminous and heating gas from hydrocarbonaceous fluids, and in the methods of using and applying such gas for illuminating and heating purposes.*" Provisional protection only obtained. Dated Aug. 2, 1869.

This invention relates, first, to taking the gas as generated by any of the established processes of generating gas from hydrocarbonaceous fluids, and combining it with another dose of atmospheric air or pure oxygen gas, and in using a compound jet to commingle or combine these gases together, for the purpose of illuminating or heating. Second, instead of supplying atmospheric air by mechanical means, as described in Hengst and Watson's patent, dated June 18, 1868 (No. 1980), the atmospheric air is supplied by means of an inflated air-chamber worked under pressure, for the purpose of aërating the hydrocarbonaceous fluid. The chamber may be made in the form of an ordinary gasholder, or in the form of a bag or bellows, constructed with flexible sides, the top and partitions running in guide-rods, such receiver to be supplied with atmospheric air by an air-pump or bellows.]

2319.—James Pinchbeck, of Whiskin Street, Clerkenwell, in the co. of Middlesex, for "*Improvements in gas-meters.*" Patent dated Aug. 3, 1869.

This invention relates to improvements in dry gas-meters, and is intended to regulate the flow of and prevent any undue pressure of gas upon the diaphragms of the measuring-chambers and valves of the same, thereby decreasing the liability to leakage and consequent inaccuracy of registration. This is effected by constructing in the upper part of the meter a box or chamber closed at the bottom and divided horizontally by a metal diaphragm, having a hole in its centre, and which serves as a valve-seat. Above the rigid diaphragm is a flexible diaphragm made of leather or other suitable material, to which is attached a spindle terminating in a conical valve. The gas inlet to the chamber is below the metal diaphragm, while the outlet from the same is above and between it and the flexible diaphragm. The consequence is that upon any excessive pressure being applied, the flexible diaphragm rises and partially closes the valve, and thus regulates the flow of gas to the measuring-chambers, the diaphragm being weighted, or the valve itself being made of such weight as to give the requisite pressure.

APPLICATIONS FOR LETTERS PATENT.

2238.—William James, of City Road, in the co. of Middlesex, for "*Improved mechanical arrangements for drawing off liquids from beer casks, barrels, and other vessels.*" Aug. 12, 1870.

2242.—William Oliver Johnston, of the town and co. of Newcastle-upon-Tyne, engineer, for "*Improvements in the production of cast-iron pipes, columns, and other similar castings.*" Aug. 12, 1870.

2248.—Alexander Prince, of 4, Trafalgar Square, Charing Cross, in the co. of Middlesex, for "*Improvements in generating gas from petroleum and other oleaginous substances, and in the apparatus to be employed therein.*" A communication. Aug. 12, 1870.

2275.—Alfred Willmer Pocock, of Pimlico, in the co. of Middlesex, engineer, for "*Improvements in meters for measuring water and other liquids.*" Aug. 17, 1870.

2278.—William Harvey, of Brewer Street, in the co. of Middlesex, gas and hot water engineer, for "*Improvements in the construction of water-cocks and gas-cocks.*" Aug. 17, 1870.

2290.—Arthur Cooper, of Twickenham, in the co. of Middlesex, for "*An improved ventilating roller window-blind.*". Aug. 19, 1870.

2297.—Joseph Judge Hays, of Hertingforbury, in the co. of Hertford, gentleman, for "*Improvements in purifying, deodorizing, and utilizing sewage and other refuse and deleterious matters, and for machinery therein employed.*" Aug. 20, 1870.

2319.—Frederick Holmes, of Gritton Terrace, Victoria Park, in the co. of Middlesex, for "*Improvements in pumps.*" Aug. 23, 1870.

2331.—Albert Marcius Silber, of Wood Street, Cheapside, in the City of London, merchant, for "*Improvements in apparatus for lighting and heating purposes.*" Aug. 24, 1870.

2338.—Alfred Vincent Newton, of 66, Chancery Lane, in the co. of Middlesex, mechanical draughtsman, for "*Improvements in liquid-meters.*" A communication. Aug. 25, 1870.

GRANTS OF PROVISIONAL PROTECTION.

2194.—Sigismund Leoni, of 34, Paul Street, New North Road, in the co. of Middlesex, manufacturer, for "*Improvements in apparatus for disinfecting, purifying, and drying, and also for cooking by heated air.*" Aug. 6, 1870.

2200.—James Garth Marshall, of Holbeck, Leeds, in the co. of York, flax spinner, for "*Improvements in ventilation and in the purification of air.*" Aug. 8, 1870.

2224.—Nicholas Demetrius Spartali, of Liverpool, in the co. of Lancaster, steam-ship agent, for "*Improvements in apparatus for compressing air and raising and forcing fluids.*" Aug. 10, 1870.

2217.—George Huntriss, colliery manager, John Swinburn, engineer, and James Wilson, colliery viewer, all of Barnsley, in the co. of York, for "*Improvents in means or apparatus for supplying mines and other places with lighting gas.*" Aug. 10, 1870.

2228.—Edmund William Pyle Taunton, of Birmingham, in the co. of Warwick, manufacturer, for "*Improvements in pumps for raising and forcing liquids.*" A communication. Aug. 11, 1870.

2248.—Alexander Prince, of 4, Trafalgar Square, Charing Cross, in the co. of Middlesex, for "*Improvements in generating gas from petroleum and other oleaginous substances, and in the apparatus to be employed therein.*" A communication. Aug. 12, 1870.

2278.—William Harvey, of Brewer Street, in the co. of Middlesex, gas and hot water engineer, for "*Improvements in the construction of water-cocks and gas-cocks.*" Aug. 17, 1870.

NOTICES TO PROCEED.

1006.—Isham Baggs, of High Holborn, in the co. of Middlesex, scientific chemist, for "*Improvements in making the carbonates of ammonia.*" April 6, 1870.

1099.—Robert John Everett, of West Ham, in the co. of Essex, for "*An improved method of treating and utilizing some of the waste products resulting from the purifying of gas in gas-works.*" April 14, 1870.

1117.—Nicholas Murphy, of Norwood, Queenstown, Ireland, distiller, for "*An improved method of and apparatus for securing and measuring liquids.*" April 16, 1870.

1329.—Bernard Hippolyte Chameroy, of the city of Brussels, in the kingdom of Belgium, mechanician, for "*Improvements in cocks.*" May 10, 1870.

2074.—William James Johnson, of Allendale, in the co. of Northumberland, for "*Improvements in apparatus for condensing metallic and other fumes, gases, and smoke.*" July 23, 1870.

2083.—William Edward Newton, of 66, Chancery Lane, in the co. of Middlesex, civil engineer, for "*Improvements in apparatus for the manufacture of gas.*" A communication. July 23, 1870.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

464.—Laurent Lucon and Zoé Peigné, Widow Kern, of Nantes, and of 37, Boulevard Bonne Nouvelle, Paris, in the empire of France, for "*An improved horizontal pump.*" Feb. 17, 1870.

481.—Richard Hunt, of Scarborough, in the co. of York, hotel keeper, for "*An improved apparatus or receptacle for storing and for withdrawing wine or other liquids, part of which apparatus is also applicable wherever a tap may be required.*" Feb. 18, 1870.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

2173.—Edmund Smith, "*Improvements in gas-regulators.*" July 26, 1867.

2179.—William Edward Newton, "*An improved water and gas meter.*" July 27, 1867.

2180.—Paul Alexandre Rohart, "*Improvements in the manufacture of gases for the production of light, heat, and motive power, and in apparatus for that purpose.*" July 27, 1867.

2194.—DAVID HODGE and ROBERT CHRISTOPHER WHITTY, "*Improvements in apparatus to be used in making gas from petroleum and other liquids.*" July 29, 1867.

2254.—WALTER WATSON HUGHES, "*Improvements in apparatus for propelling vessels and pumping or raising water.*" Aug. 3, 1867.

2278.—FRANCIS CARR MARSHALL and HUGH STEWART, "*Improvements in machinery or apparatus for raising or forcing water or other fluids, and for the transmission of the motive power of water, steam, or other fluid or gases.*" Aug. 7, 1867.

2297.—CAROLINE HOHGREFE, "*Improvements in apparatus to be applied to chimney-tops.*" Aug. 9, 1867.

2300.—JOHN DAVENPORT and JOHN KITSON, "*Improvements in or applicable to slide-valves for admitting the flow or passage of steam, water, or other fluids and gases when pressed.*" Aug. 10, 1867.

2320.—HENRY THOMAS EVERIST, "*Improvements in apparatus used in the manufacture of gas.*" Aug. 13, 1867.

2334.—WILLIAM BRADSHAW LEACHMAN and JOHN HOLROYD, "*Improved apparatus for pumping fluids.*" Aug. 14, 1867.

PATENT WHICH HAS BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £100 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

1978.—JOHN THOMSON KING, "*Improvements in apparatus for containing and distributing gas for lighting railway carriages, steamboats, and other moveable vehicles and vessels, railway stations, and other places; parts of such apparatus being suitable for governing the supply of gas and air for various purposes.*" Aug. 11, 1863.

Share List of Metropolitan Gas Companies.

Number of Shares issued.	Amount per share.	Name of Company.	Amount paid up p. Share.	Dividend p. Cent. p. Annum.	Latest Quotations.
	£		£ s. d.	£ s. d.	£
8000	10	Anglo-Romano	10 0 0	10 0 0	11 — 12
5000	20	Bahia (Limited)	20 0 0	3 0 0	13 — 14
1000	20	Do., preference	20 0 0	10 0 0	25 — 27
750	20	Do., do., redeemable	20 0 0	10 0 0	20 — 22
40000	5	Bombay (Limited)	5 0 0	4 10 0	5¾— 6
10000	5	Do., third issue	4 0 0	4 10 0	4¾— 5
10000	20	British (Limited). (Norwich, Hull-Sculcoates, Hanley, Tunstall & Shelton [Potteries], Trowbridge, & Holywell.)	20 0 0	10 0 0	30 — 31
7500	20	Cagliari (Limited)	20 0 0	7 0 0	
112000	10	*Chartered*, A shares	10 0 0	8 0 0	12½— 13
8000	10	Do., do.	5 0 0	8 0 0	6¼— 6⅔
10000	10	Do., B shares, 4 per cent. max.	10 0 0	4 0 0	6¼— 7
25000	10	Do., 5 per cent. preference	2 0 0	5 0 0	3 — 3½
20000	10	Do., 10 per cent. preference	10 0 0	10 0 0	18 — 19
17490	25	*Commercial*	25 0 0	10 0 0	38 — 40
20000	20	Continental Union	20 0 0	8 0 0	25 — 27
10000	10	Do., new	5 0 0	..	7¼— 8½
5213	20	Do., preference	20 0 0	7 0 0	25 — 26
5000	10	*Crystal Palace District*	10 0 0	10 0 0	16 — 16½
5000	10	Do., preference	10 0 0	6 0 0	11 — 11½
10000	10	Do., new shares	10 0 0	7 0 0	12 — 12½
4000	50	*Equitable*	50 0 0	10 0 0	82 — 84
4000	25	Do., new shares	25 0 0	10 0 0	41 — 42
23406	10	European (Limited)	10 0 0	11 0 0	16 — 17
12000	10	Do., new shares (Boulogne, Amiens, Rouen, Caen, Havre, & Nantes.)	5 0 0	11 0 0	8 — 9
5000	10	Hong Kong (Limited)	10 0 0	9 0 0	11 — 12
26000	50	*Imperial*	50 0 0	10 0 0	80 — 81
26000	10	Do., new shares	7 0 0	10 0 0	12½— 13
26000	12½	Do., new shares	12 10 0	7 0 0	14 — 15
1300	100	Do., bonds	£100	10 0 0	175 —180
56000	50	*Imperial Continental* (Amsterdam, Berlin, Ghent, Hanover, Lille, Rotterdam, Aix-la-Chapelle, Antwerp, Bordeaux, Brussels, Cologne, Frankfort-on-Maine, Haarlem, Stolberg, Toulouse, & Vienna.)	43 15 0	9 2 6	60 — 62
400	100	Imperial Mexican (Limited)	100 0 0	nil.	
200	100	Do., new	100 0 0	nil.	
3000	40	*Independent*	40 0 0	10 0 0	64 — 65
3000	10	Do.	10 0 0	5 0 0	7 — 9
3000	20	Do.	15 0 0	7 10 0	17 — 18
7133	50	*London*	50 0 0	10 0 0	79 — 81
5610	25	Do., 1st preference	25 0 0	6 0 0	28 — 30
503	50	Do., 2nd preference	50 0 0	6 0 0	
214	50	Do., 3rd preference	50 0 0	6 0 0	
£18781		Do., 1st preference stock		6 0 0	
£11828		Do., 2nd preference stock		5 0 0	
		Nictheroy, Brazil (Limited)			
15000	5	Malta and Mediterranean (Limited)	5 0 0	4 10 0	3½— 4
6000	5	Do., preference	5 0 0	7 0 0	4¾— 5¼
30000	5	Oriental (Calcutta)	5 0 0	10 0 0	8 — 8½
30000	5	Do., new shares	1 10 0	10 0 0	3 — 3½
10000	5	Ottoman (Limited)	5 0 0	nil.	2 — 2¼
14000	10	Parà (Limited)	10 0 0	10 0 0	10 — 11
27000	20	*Phœnix*	20 0 0	10 0 0	31 — 32
3600	100	Do., new	40 0 0	7 10 0	46 — 46½
144000	Sk.	Do.	100 0 0	5 0 0	82 — 84
5000	20	*Ratcliff*	20 0 0	10 0 0	27 — 28
	20	Rio de Janeiro (Limited)	20 0 0	10 0 0	27 — 29
6959	5	Singapore (Limited)	5 0 0	7 0 0	
2000	5	Do., preference	5 0 0	7 10 0	
1500	32½	Shanghai	32 10 0	12 0 0	
4000	50	*South Metropolitan*	50 0 0	10 0 0	65 — 67
4000	12½	Do.	12 10 0	10 0 0	20 — 21
20000	12½	Do., new shares	1 0 0	10 0 0	3⅞— 4¼
15000	10	*Surrey Consumers*	10 0 0	10 0 0	15 — 16
10000	10	Do., new	6 0 0	10 0 0	10 — 10½
9000	4	United General (Limerick)	4 0 0	5 0 0	2½— 2¾
1500	10	*Wandsworth and Putney*	10 0 0	10 0 0	10 — 12
1500	10	Do.	10 0 0	7 10 0	
1819	10	Do.	10 0 0	7 10 0	
1138	10	Do.	5 0 0	7 10 0	
20000	10	Western (Limited) A shares	10 0 0	10 0 0	16 — 17
10000	10	Do., B shares	8 0 0	10 0 0	14½— 15
10000	10	Do., C shares	8 0 0	10 0 0	13 — 13½
20000	10	Do., D shares	1 0 0	10 0 0	2½— 3
16000	5	*West Ham*	5 0 0	7 10 0	7 — 7¼
551	10	West London Junction (Limited)	10 0 0	6 0 0	
520	10	Do., preference	10 0 0	6 0 0	

Price Current.

CASTINGS.—*Per Ton.*

Average Weight of Cast-iron Gas-pipes, per Yard.

1 in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lb.

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow.	Newcastle and Middlesboro'.	Wales.	Yorkshire, Derbyshire, and Staffordshire.
	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
Pig Iron, No. 1 (g.m.b.)	3 17 6	2 11 6	2 12 6	3 10 0	3 15 0
1¼ and 2-inch Socket-pipes	7 0 0	5 15 0	5 10 0	6 0 0	7 0 0
2½ and 3-inch ditto	6 10 0	5 5 0	5 0 0	5 15 0	6 10 0
4 and 5-inch ditto	6 0 0	4 15 0	4 10 0	5 5 0	6 0 0
6 inches and upwards ditto	5 15 0	4 5 0	4 0 0	5 0 0	5 15 0
Retorts, 1st fusion, hot blast	5 10 0	4 10 0	4 5 0	5 0 0	5 10 0
Ditto, 2nd ditto, cold ditto	5 10 0	—	—	—	5 10 0
Tank-plates, ¼ thick and above	6 0 0	5 0 0	4 15 0	5 10 0	6 0 0

WROUGHT-IRON TUBING,

Subject to 60 per cent. Discount.

	2 in.	1¼ in.	1½ in.	1 in.	¾ in.	½ in.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Patent Welded Tubes, from 2 to 14 feet—per foot	1 8	1 1	0 10	0 7	0 5	0 4½
Ditto ditto, from 12 in. to 23½ in.—each	3 0	2 0	1 6	1 1	0 9	0 8
Long Screws, from 12 in. upwards	4 0	2 3	2 0	1 8	1 2	0 11
Bends and Springs	4 3	2 3	1 9	1 3	0 11	0 8
Square Elbows, equal or reducing; Round Elbows, 5 per cent. extra	3 9	2 3	1 9	1 3	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 9
Crosses, ditto, equal or reducing	4 9	3 6	3 0	2 3	1 9	1 6
Iron Cocks	20 9	13 0	10 9	7 3	5 0	3 8
Ditto, with brass plug	28 0	16 0	13 0	7 0	5 6	4 6
Diminishing Sockets, Caps, Plugs, and Nipples	1 3	0 9	0 8	0 6	0 5	0 4½
Plain Sockets	1 0	0 8	0 7	0 5	0 4	0 3
Syphons, 2-quart	15 0	14 0	13 6	13 0	13 0	—

GAS COALS.

Newcastle—Unscreened:—	Per Ton. 6s. 6d.
Haswells, Nettlesworth Primrose, and South Pelaw	
Felling, Framwell Gate, North Pelton, Redheugh Main, Walker's Primrose, West Wear, and Whitwell Primrose	6 9
Burnhope, Craghead, Charlaw, Derwent, East Castle, Edmondsley, Eighton Moor, Hartlepool Pelaw, Holmside, Lambton's Gas, Lanchester Pelaw, Medomsley, Mickley, New Pelaw, Pelaw Main, Ravensworth, Seaham, South Moor Pelton, South Leverson, Townley Main, Tyne Main, West Pelaw, Wearmouth Hutton, and Witton	7 0
Pearth, Ravensworth Pelaw, Waldridge, West Garesfield, and West Pelton	7 3
Brancepeth, Dean's Primrose, Londonderry Gas, New Pelton, Pelton, South Pearth, Stella, Urpeth, Washington Hutton, and West Leverson	7 6
Ramsay's Newcastle Cannel	14 0
Wigan Cannel (at Liverpool)	17 0
Welsh Cannel:—	
Coppa Cannel (on rails at Birkenhead), 13s. 6d.; ditto (on rails at Connah's Quay)	13 0

Scotch Cannel, f.o.b.:—	Per Ton.	*Scotch Cannel*, f.o.b.:—	Per Ton.
Boghead—at Bo'ness, 47s. 6d.; at Leith 48s. 2d		Arniston (at Leith)	31s. 0d
Muirkirk	27 0	Wemyss (at Wemyss)	20 0
Kirkness, best (at Burntisland)	22 6	Haywood and Co.'s Haywood (at Granton)	20 0
Capeldrae, 1st quality (at ditto)	22 6	Pirnie, or Methill	17 0
Ditto, 2nd ditto (at ditto)	17 6	Lothian's Cannel (at Leith)	24 6
Cowdenbeath (at ditto)	12 0	Grange ditto (at Bridgeness)	17 6
Lochgelly (at ditto)	12 0	Kinniel ditto (at Bo'ness)	17 6
Donnibristle—at Burntisland, 12s.; at Aberdour	12 6	Myles' ditto	23 6
Auchinheath Lesmahago (at Granton)	27 0	Lochore Parrot (at Burntisland)	22 6
Nitshill and Lesmahago Coal Company (at Granton)	27 6	Lanemark (at Glasgow)	16 0
		Elphinstone Tower (at Leith)	20 0

FREIGHTS.

Coastwise—Newcastle:—	Per Ton.	*Foreign:*—	Per Keel.
Chatham and Rochester . 5s. 9d. to	6s. 3d	Barcelona	£22 0s
Cork	9 6	Bordeaux	12 0
Dover, Folkestone, and Ramsgate	6 9	Boulogne and Calais	8 0
Dublin	10 0	Cadiz	12 0
Exeter Quay	9 6	Cronstadt	9 10
Ipswich	5 0	Copenhagen	9 0
London (from Leith)	8	Hamburg	18 0
London (Pool)	5 9	Havre de Grace	—
Lowestoft and Yarmouth	4 6	Leghorn	16 0
Portsmouth & Southampton . 6s. 6d. to	7 0	Lisbon	21 0
Plymouth	8 6	Rotterdam	14 0
Shoreham	7 0	Stettin	8 0
Whitstable . 6s. 9d. to	7 0	Trieste	—
Weymouth	8 0	Venice	22 0
			24 0

SUNDRIES.

Best Newcastle Fire-bricks, per 1000	£2 10s. to £2 15s. 0d.
Cliff's Fire-bricks (at Wortley), per 1000	2 15 6
Ingham's ditto (at Wortley), per 1000	2 15 0
Farnley Iron Co.'s Fire-bricks (at Wortley), less discount	2 17 0
Fire-clay Retorts, per foot run	5s. 6d. to 0 7 6
Tarred Rope Yarn, per cwt.	1 0 0

THE

DUKE OF HAMILTON'S

LESMAHAGOW

CANNEL COAL.

LESSEES:

THE NITSHILL & LESMAHAGOW COAL COMPANY.

OFFICE:

37, ST. VINCENT PLACE,

GLASGOW,

Where all communications are requested to be addressed.

TO GAS ENGINEERS.

WANTED, a gentleman who thoroughly understands GAS ENGINEERING in all its branches; also must be a good draughtsman and competent to draw up estimates from plans. None need apply unless practically acquainted with the fitting up of large buildings.

Apply by letter, stating salary and also where last employed, to Mr. C. DEFRIES, 147, HOUNDSDITCH.

BOROUGH OF MIDDLESBOROUGH.

WANTED, a Manager for the Gas-Works the property of the Corporation of the borough of Middlesborough, in the North Riding of the county of York. The person appointed to fill this office, which will be held under the title of "Gas Manager," will be required to devote the whole of his time to the duties thereof. The duties are those which are usually performed by persons filling similar offices. The Corporation, however, reserve to themselves the right of further defining and regulating these duties in the future, should they deem it advisable. The appointment will be made subject to a quarter's notice, expiring at any time being given by either party. The salary will be £125 per year, no extras whatever being allowed beyond actual disbursements incurred by authority. The requisite staff will be appointed and remunerated by the Corporation.

Applications in the handwriting of the candidates, stating age, present occupation, and the exact day upon which the applicant could, if elected, enter upon his duties, accompanied by testimonials, must be sealed and sent by post to the undersigned, marked on the outside "Application for Gas Managership," on or before the 1st day of September next.

Canvassing members of the Corporation by or on behalf of any applicant will be considered a disqualification for election. No candidates will be required to attend in Middlesborough unless officially written to for that purpose.

JNO. T. BELK, Town-Clerk.

Corporation Hall, Middlesborough,
Aug. 13, 1870.

WANTED, by the Advertiser, a situation as Working Manager, Foreman, or Meter Inspector. Is a practical gas-fitter and meter repairer, and thoroughly understands the routine of a gas-work. Aged 34. Good reference.

Address F. M., care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO GAS COMPANIES.

WANTED, by a Man aged 32, a situation as GAS-FITTER and METER INSPECTOR. Has had experience in the repairing of meters, and understands fitting in all its details, and can lay services. Satisfactory reference from last employer.

Address J. G., 5, College Street, College Green, BRISTOL.

WANTED, by an experienced and practical Working Manager, a RE-ENGAGEMENT in Gas-Works. Has had many years experience in erecting Gas-Works at home and abroad, and thoroughly understands making and distributing gas. Good testimonials.

Address W. M. C. Y., care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by the Shrewsbury Gas Company, a FOREMAN to reside on their works. He must be well acquainted with the manufacture of gas, and have had good experience in a similar capacity.

Applicants to state, in their own handwriting, age and qualifications, and reference as to ability and character. Wages 24s. per week. A married man preferred, without children.

Apply to the Manager, Mr. S. B. DARWIN, on or before the 10th of September.

TO GAS COMPANIES AND ENGINEERS.

THE Advertiser, who has just returned from abroad, after completing the erection of a large Gas-Work, is open to a RE-ENGAGEMENT in a similar capacity, or as MANAGER for an English Gas Company. Has had 14 years practical experience (home and foreign) in the management, erection, and reconstruction of all plant appertaining to Gas-Works. Satisfactory references given to engineers and Gas Companies. Speaks the Spanish language, and has a good knowledge of Portuguese and Italian. Aged 34 years.

Address J. G. O. F., 98, Malden Road, Haverstock Hill, LONDON.

A Civil Engineer who has a knowledge of gas work, and wishes to obtain thorough practical experience, would give his services for a term to an Engineer of large works. Has had much experience in foundations and hydraulic work generally.

Address Mr. EVENS, The Werfa, ABERDARE.

CONDENSER & PURIFIERS FOR SALE.

ONE Set of 3 Dry Lime Purifiers, 6 ft. by 6 ft., and 3 ft. 9 in. deep, with 6-in. connexions, wet centre-valve, wood grids, and lifting apparatus all in good working order. Also One CONDENSER, with 16 5-in. pipes, each 12 ft. long, top and bottom syphon-boxes, and 7-in. connexions; together with a Station-Meter to pass 2000 feet per hour, and an Hydraulic Main 20 ft. long by 14 in. diameter, with 9 4-in. bridge-pipes. The above will be sold either in one lot or separately, and no reasonable offer refused. JOHN CHEW, Manager.

Gas-Works, Blackpool, Lancashire,
Aug. 20, 1870.

GAS PURIFIERS FOR SALE.

A Set of Four cast-iron Gas Purifiers, 6 ft. square, with wrought-iron lids, wrought-iron hydraulic centre-valve in cast-iron case, cast-iron sieves, with 8-in. connecting-pipes, and lifting apparatus complete, in very good condition. May be seen working.

Apply to the SECRETARY, Gas-Works, Longwood, near HUDDERSFIELD.

TO CONTRACTORS OF GAS-WORKS.

THE Advertiser, a Gas Engineer, has received instructions from the Municipality of a very important Commercial City in Italy, to introduce a Company who will erect Gas-Works and illuminate their city. Also for private illumination. The terms of the intended concession, which is a favourable one, are in the possession of the Advertiser, who is now residing in Italy, translated copy of which may be obtained on payment of 10s., to be addressed to GAS, Post-Office, Gibson Place, Warwick Road, PADDINGTON, W.

SHEEPSHEAD GAS COMPANY.

NOTICE.

All ACCOUNTS against the above Company (whether previously rendered or not) are TO BE SENT IN to Mr. P. J. WATES, LOUGHBOROUGH, within three days of this notice.

Aug. 30, 1870.

CHEMICAL WORKS, SANDLING, NEAR MAIDSTONE.

MR. W. Day, Jun., will sell by Auction, on the premises, on MONDAY, Sept. 5, 1870, the whole of the PLANT of a Carbonate and Liquid Ammonia Manufactory, including four 12-ft. D Retorts complete; four Lead Condensers; two Dripping Beds; Wrought-Iron Subliming Bath, with 12 cast-iron pots; Lead Balloons and Fittings, Cast-Iron Still, with agitator; Lead Condenser; five 20-gallon Woolf Bottles. Quantity of Glass Bottles, and numerous other effects.

To be viewed on day of Sale. Sale to commence at One o'clock to the minute.

Catalogues may be obtained at the AUCTIONEER'S Offices, 23, High Street, MAIDSTONE.

TAR AND TAR-WORKS TO BE LET.

TO BE LET by Tender, for One, Three, or Five years, from the 1st of November next, the TAR-WORKS situate in Farington, near Preston, together with Tar produced at the various works belonging to the Preston Gas Company.

Tenders, endorsed "Tender for Tar, &c.," must be delivered to the undersigned, on or before Sept. 3 next.

For further particulars, apply to HENRY GREEN, Engineer.

WILLIAM INGHAM AND SONS,

WORTLEY FIRE-BRICK AND RETORT WORKS,

Near

Leeds.

W. INGHAM and SONS, having for many years been extensively engaged in the Manufacture of

RETORTS AND FIRE-BRICKS FROM THE CELEBRATED WORTLEY FIRE-CLAY

beg to call especial attention to their RETORTS, which have for many seasons proved to be unsurpassed in quality by any in the Kingdom, their FREEDOM FROM CRACKS and the ADHESION OF CARBON rendering them worthy the attention of all parties interested in the making of Gas.

The Works are of such magnitude as to ensure the prompt execution of orders to any extent.

Estimates for Setting, or Bricklayers sent when required.

GAS OVENS IN SEGMENTS OF EQUAL QUALITY.

A large Stock of Fire-Bricks, Fire-Clay, Terra Cotta, and Drain-Pipes of all Sizes kept in London at Mr. ALFRED WILLIAMS, Wharf, 64, Bankside, Southwark, where all particulars of Prices, &c., may be obtained.

N.B.—*Export orders continue to have prompt attention.*

GEORGE NEWTON,

UNION STREET WEST, OLDHAM,

MANUFACTURER OF

IMPROVED WET & DRY CONSUMERS GAS-METERS,

GAS STATION-METERS,

With all the Joints planed,

GOVERNORS, GAUGES, INDICATORS, EXHAUST GOVERNORS, &c.

TERMS, &c., ON APPLICATION.

LIVESEY FIRE-CLAY WORKS,

NEAR BLACKBURN, LANCASHIRE.

ORLANDO BROTHERS,

MANUFACTURER OF PATENT CLAY RETORTS,

AND EVERY DESCRIPTION OF

TUBULAR GLAZED SEWERAGE PIPES, BENDS, JUNCTIONS, ETC.

FIRE-BRICKS, TILES, BLOCKS, AND CHIMNEY-TOPS.

1862.

PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

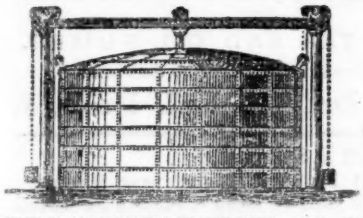
CLASS II.

This Paint having been in general use over eight years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

Reference is kindly permitted by the Engineers of the City of London, Commercial, London, and Surrey Consumers Gas Companies, who pronounce it the best Paint known for their purposes.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.



IMPROVED GAS APPARATUS,

FOR CITIES, TOWNS, VILLAGES, &c.,

INVENTED AND MANUFACTURED BY

W. C. HOLMES & CO.,

WHITESTONE IRON-WORKS, HUDDERSFIELD.

SOLE MANUFACTURERS of B. W. THURSTON'S IMPROVED SCRUBBER, CONDENSER, and WASHER, in use in many of the principal Gas-Works on the Continent.

PATENTEES of the IMPROVED COMBINED PURIFYING APPARATUS, so eminently adapted for Exportation.

ESTIMATES, PLANS, and SPECIFICATIONS PREPARED for BUILDINGS and APPARATUS.

Prospectus, Price Lists, &c., on application.

LONDON OFFICES—57, GRACECHURCH STREET, CITY.

*** *Please address letters to Huddersfield.*

REFERENCES TO NEARLY 300 GAS-WORK

LAMBERT BROTHERS, WALSALL.

ALPHA TUBE & FITTING WORKS

CAROLINE VICKARY,

(ADMINISTRATRIX TO THE LATE JOHN VICKARY,)

GAS ENGINEER, CONTRACTOR, IRON AND BRASS FOUNDER,

EXE ISLAND, EXETER,

(Established Thirty years,)

Respectfully tenders her thanks to those friends who have patronized her since her late husband's death, and having secured an efficient staff for each department of design and manufacture, she refers with confidence to works recently erected by her as a guarantee that all orders she may be favoured with will be completed in a sound and satisfactory manner.

GASHOLDERS AND TANKS,

Retorts, Retort-Fittings, Condensers, Scrubbers, Purifiers, Station-Meters, Governors, Sluice-Valves of all kinds. (Gas and Water Mains always in stock.)

GAS-FITTINGS,

Including Chandeliers, Pendants, Hall Lamps, Brackets, Star and Sun Lights of all designs, embracing the Mediæval and other periods.

GAS-METERS (WET OR DRY),

Combining the most recent improvements in principle and manufacture; upwards of 150,000 already in work, giving the highest satisfaction. (A guarantee for five years given with each one.)

Every description of **Plumbers Work,** comprising **Water-Closets, Beer-Engines, Lift and Force Pumps, Cocks for Gas, Water, or Steam, &c.**

Drawings, Specifications, and Estimates of **Gas-Works, Iron Roofs, Bridges,** and light or heavy structures in wrought or cast iron, supplied on application.

CANNEL COAL.—The West Yorkshire Iron and Coal Company, Limited, beg to draw the attention of Gas Companies to their Cannel, of which the following is the analysis made by W. Huggon, Esq., F.C.S.:

Yield of gas per ton	10,296 cubic feet.
Illuminating power rather over	21 sperm candles.
Yield of coke per ton . . .	12 cwt.

The actual working, as reported by one of the largest gas companies in Yorkshire, gives results still more favourable, viz.—

Yield of gas	10,416 cubic feet.
Illuminating power	21·89 sperm candles.
Coke	The same.

We add from the same source the capabilities of the common gas coal—

Yield of gas	10,080 cubic feet.
Illuminating power	14·41 sperm candles.
Yield of coke	13 cwt.

COLLIERIES—WEST ARDSLEY, near LEEDS.

For further particulars, address to the Office of the Company, 15, York Place, LEEDS.

POPE & PEARSON'S GAS COAL.—We have now the authority of several of the most eminent Gas Engineers of London in stating that our Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles.*

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, West Riding and Silkstone Collieries, near LEEDS.

OLD WEMYSS CANNEL COAL.—Yield of gas per ton, 12,896 cubic feet; illuminating power, 31·75 standard candles. Port of shipment, Wemyss.

Analysis and price on application to Mr. WM. CAREY, Manager, Wemyss Colliery, Kirkcaldy, FIFE.

CANNEL COAL.

MESSRS. GRIFFITHS BROTHERS,
COPPA COLLIERY, MOLD,

Beg leave to call the attention of Gas Companies to the superior quality of their Cannel for gas-making purposes.

This Cannel produces in actual working, in iron retorts, 9200 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.

Ports of shipment—Birkenhead or Connah's Quay.

Waggons supplied for delivery by railway to any part of England or Wales.

For particulars, prices, and rates of freight, apply to GRIFFITHS BROTHERS, Coppa Colliery, Mold, FLINTSHIRE.

THE
HUCKNALL COLLIERY COMPANY
Can offer a CANNEL COAL yielding a large quantity of Gas of superior quality.

Prices and information on application to the HUCKNALL COLLIERY COMPANY, Hucknall Torkard Collieries, near NOTTINGHAM.

THOMAS EDINGTON & SONS,
PHŒNIX IRON-WORKS,
GLASGOW,
Manufacturers of all kinds of
GAS AND WATER PIPES,
Branches, Bends, Water-Traps, Tank-Plates, Valves, and general Castings. Also
RAILWAY CHAIRS & SLEEPERS,
AND
GRIFFIN'S PATENT PERMANENT WAY.
London Office, 63, Old Broad Street.

WALTER MABON & CO.,
Engineers,
ARDWICK IRON-WORKS,
FAIRFIELD STREET, MANCHESTER,
MANUFACTURERS OF
IRON TANKS, GASHOLDERS,
GAS APPARATUS,
PIPES, VALVES, IRON ROOFS,
WROUGHT AND CAST IRON GIRDERS.
DESIGNS, SPECIFICATIONS, & ESTIMATES FURNISHED.

FIRE-CLAY GAS-RETORTS, &c., CANNEL AND STEAM COALS.

WILLIAM FRASER, Inverkeithing (owner of the Works at which Fire-Clay Retorts were first made), having greatly enlarged his Works, can supply RETORTS and other FIRE-CLAY GOODS to any extent.

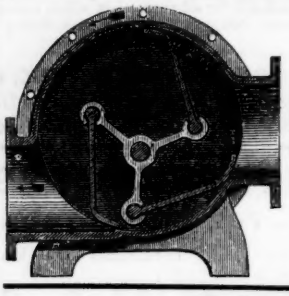
References can be given to managers of above a hundred Gas-Works whom he supplies.

WILLIAM FRASER ships COWDENBEATH PARROT COALS at Charlestown and Burntisland at 11s. per ton; and HALBEATH STEAM COALS, on Navy List, at 7s. per ton.

INTERNATIONAL EXHIBITION, 1862.
CLASS X.
PRIZE MEDAL
For excellence of Fire-Clay Gas Retorts, and
"HONOURABLE MENTION" for good quality of Fire-Bricks.
WILLIAM STEPHENSON & SONS,
THROCKLEY,
NEWCASTLE-ON-TYNE.

J. T. B. PORTER & CO.,
GAS ENGINEERS,
MANUFACTURERS AND CONTRACTORS FOR GAS-WORKS
Of any extent at Home and Abroad,
GOWTS BRIDGE WORKS, LINCOLN,
AND
JOHN STREET, ADELPHI, LONDON, W.C.

WALTER FORD,
159, GRAY'S INN ROAD, LONDON,
MANUFACTURER OF
WET & DRY GAS-METERS, STATION-METERS, GOVERNORS, &c.
SOLE MANUFACTURER OF
PADDON'S PATENT STREET-LAMP REGULATORS,
For ensuring any required consumption. These Regulators are in general and increasing use, and references can be given to Gas Companies who use them for every Lamp.



CHARLES HORSLEY'S
PATENT
GAS EXHAUSTER.
(From 250 Feet upwards per Hour.)
Also,
ROTARY TAR AND OIL PUMPS.
For particulars and prices apply to the Patentee,
22, Wharf Road, City Road, London, N.

ROBERT DEMPSTER,
Gas Engineer and Contractor, Rose Mount Foundry, Elland, near Halifax.

R. D. recommends his Fire-Brick Retorts to Engineers and Managers of Gas Companies; they last from 10 to 12 years.

Iron and Fire-Clay Retorts.
Annular and Pipe Condensers.
Scrubbers and Purifiers, all sizes.
Steam-Engines and Exhausters.
Hydraulic Centre-Valves.
Station-eMters and Governors.
Photometers & Pressure-Gauges.
Lamp-Posts and Brackets.
Cast-Iron Mains and Syphons.
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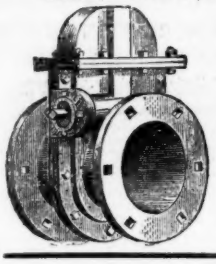
From 2 inches to 18 inches, price 9s. 6d. to 12s. per inch diameter.



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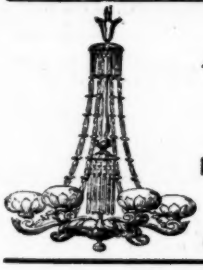

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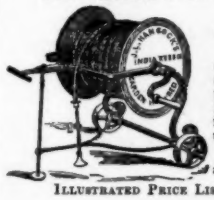

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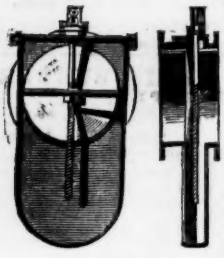
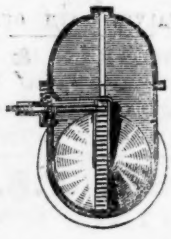
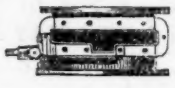


NEW FLEXIBLE VALVE

FOR

GAS & WATER WORKS.





This Valve has been designed to meet what has hitherto been felt a great want, in Gas-Works especially—namely, a *really tight* Valve which could be depended upon.

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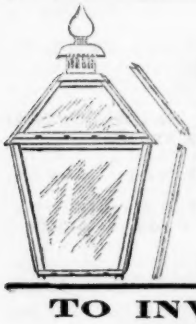

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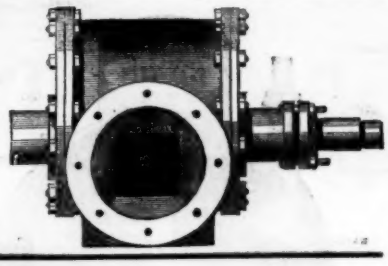

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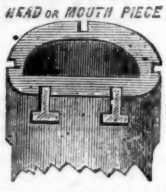

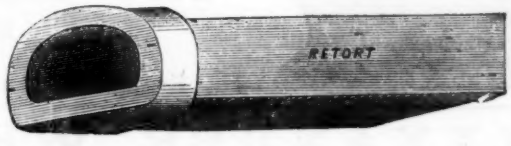

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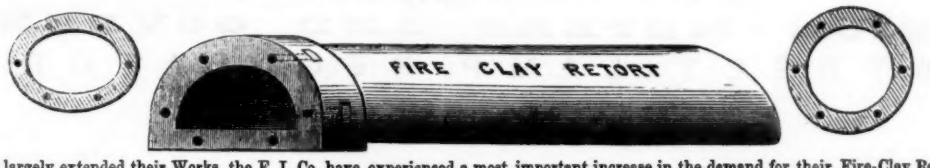

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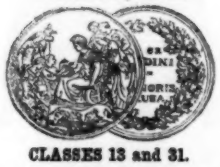

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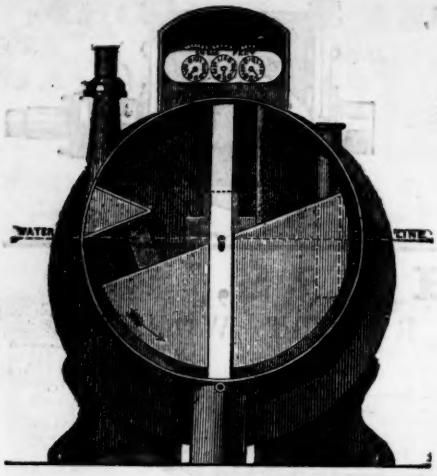

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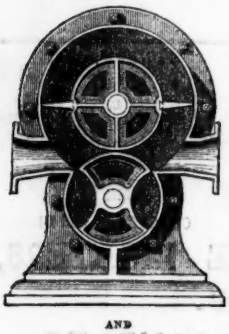

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